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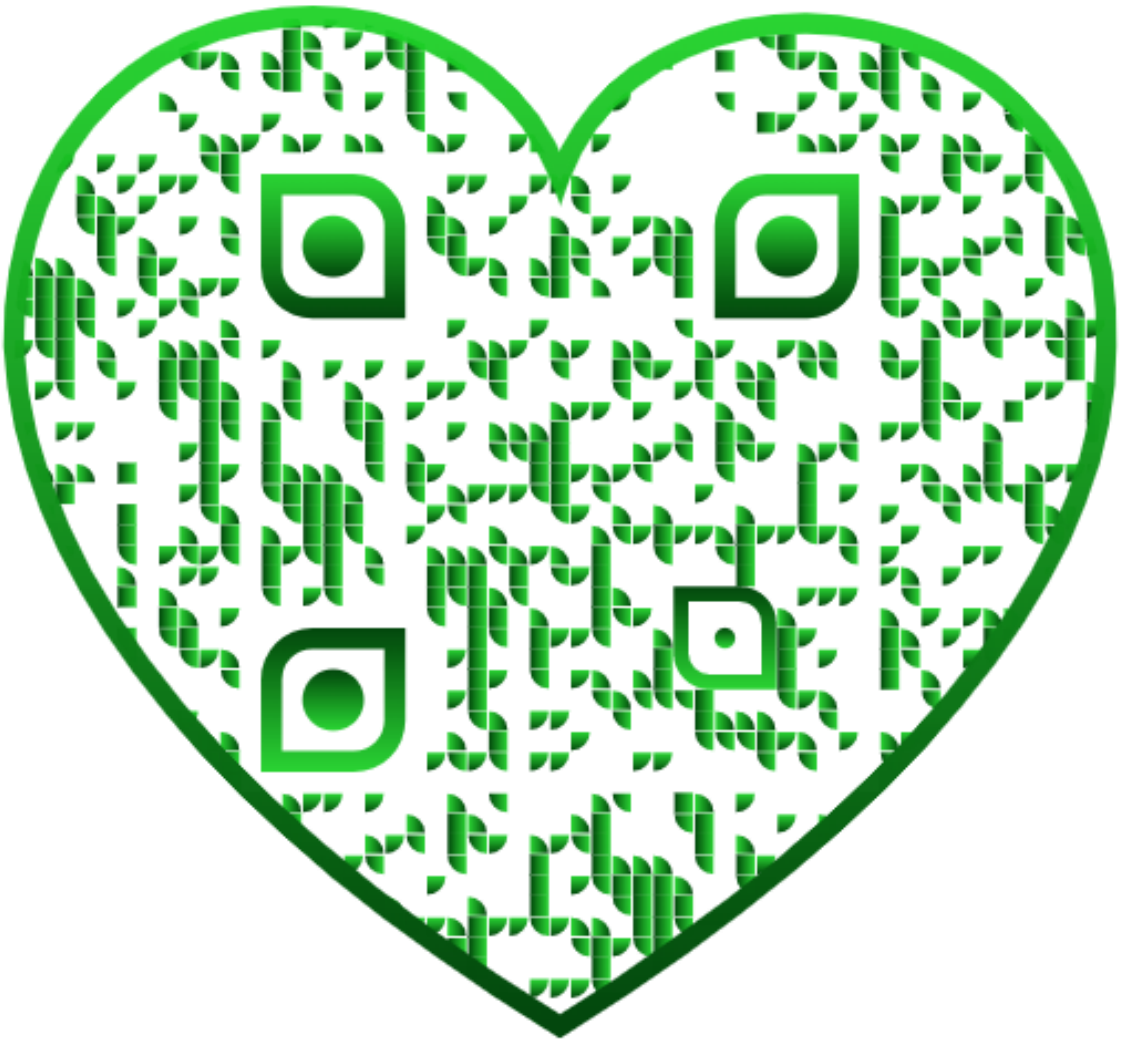

CLINICAL OPHTHALMOLOGY

(and Investigative Ophthalmology)

Authors:

Staff Members of
Department of Ophthalmology
Alexandria University

Editor in Chief:

Prof. Dr. Alaa El Samadoni

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CLINICAL OPHTHALMOLOGY

A- History

A good history is the essential part of the evaluation of every patient. Indeed, with the history alone, a skilled person can arrive at the proper medical diagnosis in 80 to 90% of patients. The history provides vital guidance for the subsequent physical examination, laboratory work, and therapy.

History is a selective guidance and progressive recognition of significant information. How, then, does a beginner proceed through the history when each patient is different and even the expert cannot know the outcome in advance.

Is history important?

- What are your benefits? and
- What are the patients benefits from history taking?

Your benefits are

1- To develop skill in communication, so that you can easily and accurately cross the barrier of understanding someone else describing his experiences.
2- To learn about that particular disease so that you will recognize its symptoms when you again encounter them in another patient.
3- To motivate your own study, so that in subsequent reading you are alert to receive the scientific explanations of why the symptoms exist.

Benefits to the patient

- You may be surprised if you know that delivery of the history is in itself one of the primary goals of every patient.
- Although we ordinarily think of the history as an information-gathering device, it is the first step required in the treatment of every patient. History taking does two separate things for each patient: Caring for the

body (localizing the affected part) and caring for his mind (part of reassurance therapy).

Reassurance therapy begins with history taking, which is the patient's introduction to the medical care system. The patient's first impression will be good or bad, depending on the skill of the historian. Note that from the patient's standpoint the history represents the large part of his verbal communication with the system and therefore assumes proportionate importance in his assessment of the system.

In summary, a good historian can reassure the patient that he has come to the right place for care.

I- Personal history

- **Name, age, sex, address**.
- **Occupation**:
  - Some occupations are liable to certain disease e.g. corneal or conjunctival foreign bodies in welders.
  - To know the visual needs of the patient.

II- Complaint

Write the complaint in the patient's words, not yours i.e. Don't try to translate it. Also write in Arabic e.g. if the patient says: "I cannot see with my right eye", you should not come to the decision that the problem is nearsightedness and write down "myopia of the right eye" as at this stage of the history you gave no way of knowing whether the cause of the problem is myopia, R.D. or something else. A premature statement of your diagnosis will compromise your ability to reach a correct final diagnosis.

Types of complaints:

1- Visual complaints

1- Diminution of vision

A- Sudden loss of vision (within minutes)

- Amaurosis fugax (transient,reversible visual loss).

- Central retinal artery occlusion.
- Severe trauma → avulsion of the optic nerve.
- Hysteria and malingering.

B- Rapid(acute) diminution of vision (within hours - days)

- Acute glaucoma.
- Keratitis(corneal ulcer).
- Acute iridocyclitis. Central retinal vein thrombosis.
- Retinal detachment.
- Vitreous hemorrhage.
- Acute optic neuritis.

C- Gradual diminution of vision (within weeks -months)

- Senile cataract.
- Primary open angle glaucoma.
- Primary optic atrophy.
- Age related macular degeneration.
- Retinopathies.
- Retinitis pigmentosa.
- Progressive myopia.
- Amblyopia.

2- Blurring or haziness of vision: Refractive errors

- For far → myopia.
- For near → hypermetropia, presbyopia.

3- Night blindness:

- Congenital.
- Acquired:
  - Vitamin A deficiency.
  - Retinitis pigmentosa.
  - Degenerative myopia.
  - Siderosis bulbi.
  - Advanced chronic glaucoma with constricted field.

4- Photophobia:

- Keratitis.
- Iritis.
- Corneal oedema e.g. due to glaucoma.
- Sympathetic ophthalmia.
- Foreign bodies.

5- Coloured halos:

- Corneal oedema.
- Incipient cataract.
- Conjunctivitis (mucopurulent).
- Prodromal attacks of angle closure glaucoma.

6- Diplopia:

- Binocular:
  - Squint (paralytic).
  - Anisometropia (if corrected with glasses).
- Uniocular:
  - Sublaxated lens.
  - Iridodialysis.
  - Incipient cataract.
  - Irregular astigmatism.

7- Photopsia (flashes of light)

Due to irritation of the cones e.g. due to vitreous traction on the retina,or with the onset of retinal break.

8- Other C/O e.g.

- Macropsia (larger image)
- Micropsia (smaller image)
- Metamorphopsia (distorted image)

} R.D., retinitis, macular scar, macular edema

9- Colour blindness: is hereditary.

2-Non visual complaints

1- Discharge

- Watery
- Mucopurulent
- Purulent
- Sanguinous (blood tinged): in membranous conjunctivitis.
- Ropy discharge: in allergic conj. e.g spring catarrh.

2- Pain

We inquire about:

- Type:
  - Throbbing → Stye
  - Burning → Conjunctivitis
  - Grittiness → Trachoma and dry eye (xerosis)
  - Neuralgic → Iridocyclitis
  - Bursting → Acute glaucoma
- Site and where it is referred.
- Duration.
- Mode of onset.

3- Itching: Allergic conjunctivitis.

4- Foreign body sensation e.g. in corneal ulcer, dryness and PTCs.

5- Swelling

6- Cosmetic disfigurement

III- History of the present illness

This description of the patient's chief complaint should be in sufficient detail so that the reader will understand the symptoms and the course of the disorder. The history should not be written down just as the patient states it, because most patients offer a disorganized and incomplete data "You should listen and question until you have obtained material that you can write down in an orderly sequence that makes sense to you".

First, Question the patient about his complaint until you understand his specific problem clearly. You will find that most patients have difficulty providing precise and concise descriptions. e.g., if the patient's complaint is "I cannot see with my right eye", this might mean:

- Only distance vision is blurred.
- A blind spot is present in the center of the visual field.
- The right side of the visual field of the right eye is lost.
- The right visual field of both eyes is lost.
- Or a variety of other ways in which sight is impaired.

Each of these has different diagnostic implications.

Second, Analyse each complaint as regards:

- Mode of onset: Sudden, acute, gradual.
- Course: Progressive, regressive, stationary.
- Duration.
- Associated symptoms: e.g. loss of vision ± Pain.
- Constant or intermittent.
- Variable or consistent.
- Right, left or bilateral.

Third, You must know and write down what has previously been done about the problem. Has the patient obtained medical advice? What medication have been taken and what has resulted? You will understand that repeating a treatment that has already been unsuccessful is not sensible. Be very specific as to the name and dose of medication and ask if the patient had faithfully used the treatment as prescribed (at least 1/3 of the patients do not take their medications properly!).

IV- Past history

A- The most relevant part of the past history is to ask if similar or related problems have existed before. If you do not possess enough medical knowledge to know what related problems might be, it is always

reasonable to ask if the patient had in the past experienced similar symptoms or other problems with the same part of the body e.g.,

- Did you ever had trouble seeing with the right eye?
- Have you ever had any trouble with your eyes?
- Have you had eye surgery?
- Specify and date, in chronological order, the major illness and operations of the patient. Be more interested in recent problems than ancient ones.
- Childhood measles is not usually relevant in an 80-year-old patient.

B- The past use of medications is important. List prescribed medications then how much and how often, any allergies or toxic reactions… etc.

C- History of previous glasses.

V- Medical history

A- We routinely ask about D.M. and hypertension as they can affect the eyes in a large number of ways.

B- Ask about any other systemic diseases which could be relevant to the present ocular conditions.

VI- Family history

All major eye problems suffered by family members are relevant to an ophthalmic history. Of course, many eye conditions are inherited including refractive errors, retinoblastoma, glaucoma, retinal degenerations.

Summary

You should devote much time to perfect your ability to take a history. Perhaps, 80% of diagnosis can be suspected on the basis of a history alone. Simultaneously, as the eliciting of a history provides you with information, it begins formation of the patient attitudes necessary for confidence and reassurance.

Remember

That reading about how to take a history or to play the piano is nice, but it does not result in capability to perform the given task. You must actually go forth and take histories before you learn how to do this. The following outline is suggested as a guide for you.

Please use it right away, on the next patient you can find.

1- Write a concise description of the eye complaint.
2- What is the diagnosis (D.D.) suggested by this history?
3- What questions will help to confirm or exclude this diagnosis?
4- What physical examinations and laboratory findings will help to confirm (significant positive) or exclude (significant negative) this diagnosis suggested by the history?

What is your goal in an eye history?

That you should be able to point to the part of the visual system that is affected, which requires especially alert physical examination. Sometimes the history will not only localize the malfunction but will be so specific as to permit an etiologic diagnosis also.

B- General look of the patient

A good doctor is a good inspector. From inspection of the patient, you can get very useful information or even you can diagnose some diseases:

1- You can get an idea about the vision of the patient from the way he enters the exam. room.
   If he is helped by another person → poor vision.
   If he enters quickly to the exam. chair → good vision.
   Narrowing of the palpebral fissure → myope.
2- Looking at the glasses of the patient → you can know whether he is myope or hypermetrope.
3- Chin elevation and frowning of the forehead → ptosis.
4- Abnormal head posture → paralytic squint.
5- Any swellings.

6- Squint.
7- Looking at the patient's hands →→ tremors, dirty hands → unfit for contact lenses.
8- Dressing (clothes) → idea about the economic status → suitable treatment as regard its price especially if they are going to use for long time.
9- One eyed person→ usually overestimates any affection of the other eye and needs special handling.

C- Ophthalmological examination

We always start by testing the visual acuity then proceed to eye lid examination, lacrimal system, extraocular muscles, conjunctiva, comea... and so on as explained in the following pages.

THE ACUITY OF VISION

The acuity of distant central vision is tested by the means of **illiterate E. chart** or **Landolt broken rings**. It may be tested also using Snellen's charts. These are constructed upon the standard that the average minimum visual angle is 1 min.

The type consist of a series of letters or broken rings arranged in lines each diminishing in size. The breadth of the lines of which the letters or rings are composed, in such that the edges will subtend an angle of 1 min at the nodal point of the eye at a particular distance. This is called: the minimum visual angle. Each letter or ring is of such a shape that it can be placed in a square the sides of which subtend an angle of 5 min at the nodal point of the eye at the given distance.

Thus, the largest letter subtends 5 min at the nodal point if it is 60 m. from the eye. Those in the subsequent lines will subtend 5 min. If they are 36, 24, 18, 12, 9 and 6 m. from the eye.

For convenience, the patient is kept at a fixed distance from the types. This distance could never be less than 5 and preferably 6 m. At such a distance the divergence of the rays in the small bundle which enters the

pupil is so light that the rays can be considered parallel and accommodation is thus eliminated. If a patient can only read the 18 m. line, his distant vision is obviously defective. The numerical convention which is used to record this is a fraction in which the numerator is the distance at which he is from the types and denominator is the distance at which person with normal vision ought to be able to reach the last line which he succeeds in reading. The patient examined will therefore have his distant vision recorded thus;

VA = 6/18. The normal person's vision will be VA = 6/6.

These fractions should not be reduced, because they are conventions giving an accurate numerical estimate under special conditions. In its original form it indicates the actual types used and the distance away from the test-types.

If the patient cannot read the largest letter he is told to walk toward the types. At a certain distance he may be able to see the top letter. In this matter the farthest point at which he can distinguish the top letter is determined. If this is 3 m, the vision is recorded thus VA = 3/60. If he is unable to see the top letter when close to it (up to 1 m), he is asked to count the extended fingers, if he could count them at 70 cm distance, vision is recorded as: CF 70 cm, the surgeon's hand is moved in front of the eye; if he can distinguish the movements, the vision is recorded as VA = hand movements or HM. If he is unable to see these he is taken into the dark room and light is concentrated on his eyes and he is asked to say when the light is on the eyes and when it is off. If he succeeds in doing this, VA = PL (perception of light). If he fails to see the light the vision is recorded as VA = no PL.

The measurement gives the visual acuity of the eye unaided by lenses (called: unaided VA). It is necessary in all cases, however, to determine the function of the macula in the best optical conditions and for this purpose the refraction of the eye is done and the visual acuity taken again in the same way with the correcting glasses in place (called: best corrected VA).

Pinhole test:

If the patient's vision is less than 6/6 and he does not have glasses, you have a simple test to do which will help you to differentiate between many conditions;this is Pinhole test: the patient looks through a stenopaeic aperture and visual acuity is remeasured.

- If the defective vision is due to a refractive error it will be better by this test, (also it will improve in partial cataract).
- If it is due to macular lesion it will get worse by this test.

The amount of illumination on the test card has a considerable influence on normal vision acuity. It has been found that the acuity rises rapidly as the illumination is increased from zero up to 5-10 foot candles and more slowly up to 1000 or more ft. cs. The illumination of the test card should never be allowed to fall below 20 ft. cs.

Visual acuity testing in children:

The ordinary test-types cannot be used with young children. **Simple pictures** constructed on Snellen's principles may be used. A very effective test is the **E-test** wherein the examiner holds in various cards whereon is printed the E in various sizes (or broken rings) and the child standing 6 m. away, if the matter is treated as a game, will readily respond on request by indicating the direction of the letter with his hand or by holding a similar card in the same positions so long as he sees it.

An objective measure of the visual acuity may be made by utilizing the physiological phenomenon of **optico-kinetic nystagmus.** If a white drum with vertical black stripes is rotated before the eyes, they follow a stripe with a slow motion and then as it disappears, switched suddenly back to pick up a new stripe. This is an automatic reflex persisting so long as the individual stripes are seen, and by varying their breadth or the distance of the patient from the drum, as assessment of the acuity can be made, particularly by infants, uncooperative or malingering patients. It is interesting that in cases of hemianopia the response is absent in lesions of the parietal lobe.

Testing the near (reading vision):

It is done in patients with an acuity of counting fingers or more. It is done using a near (reading) chart at a standard distance of 30 cm. Each eye is tested separately. This test is specially very important in evaluating and properly correcting presbyopic patients.

Contrast sensitivity:

Afferent visual function can also be measured by assessing the patient's ability to detect differences in contrast. This may be tested with the Pelli-Robson Letter Chart, in which letters decrease in contrast not in size. This is more sensitive indicator than Snellen's chart acuity and may provide earlier detection of retinal and optic nerve disease.

EXAMINATION OF THE EYELIDS

Objectives:

- To ascertain the adequacy of the protection of the eyes.
- To elicit signs that point to systemic diseases.
- To detect local eyelid diseases.

1- Examine the palpebral aperture for size and shape

- Normally, this space ranges from 28-30 mm horizontally. This measurement is not so important as it is a disparity between both eyes. If it is diminished it is called blepharophimosis. Shape and slant: note if there is a mongoloid or an antimongoloid slope.

2- Position of the lids

- Normally, the upper lid should cover 1-2 mm from the cornea, while the lower lid should be in level with the lower limbus with no exposure of the sclera. The borders should have good anatomic apposition to the globe with the tear puncta (upper and lower punctual openings are located 2-4 mm temporal to medial canthus) in contact with the tear film that they drain.

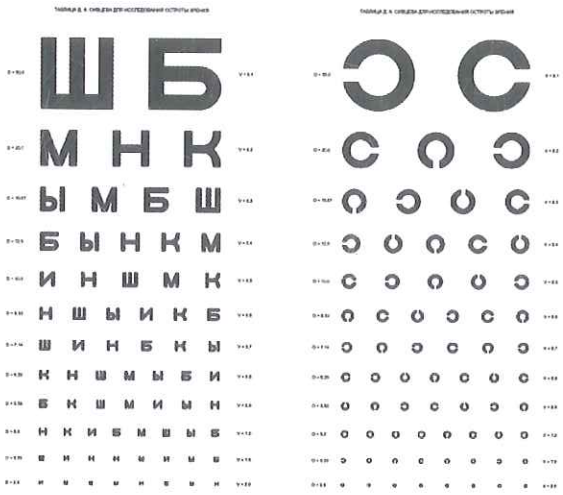


Fig. 1-a: Snellen's& Landolt charts.

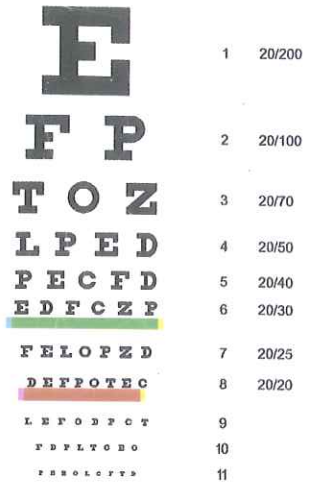


Fig. 1-b: Snellen's chart.

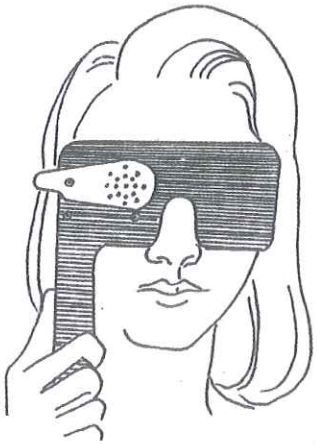


Fig. 1-b2: Pinhole test

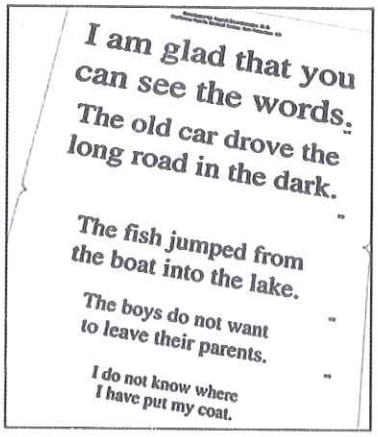

I am glad that you can see the words.
The old car drove the long road in the dark.
The fish jumped from the boat into the lake.
The boys do not want to leave their parents.
I do not know where I have put my coat.

Fig. 1-c: Near vision test chart.

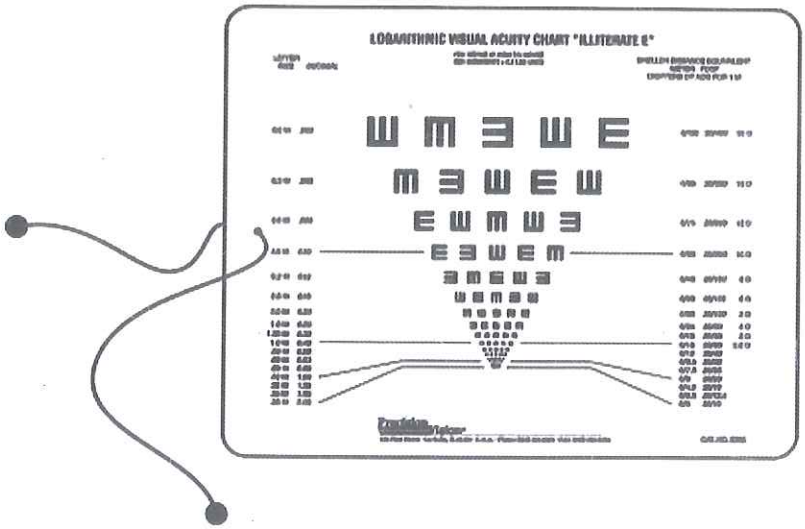


Fig. 1-d: Illiterate near vision test chart.

3- Motility of the lids

- Both upper lids should elevate well on upwards gaze and drop on down gaze.
- The lid margins should follow the globe synchronously on downward and upward gaze without evidence of lid lag.
- Voluntary lid closure should be complete with no inferior exposure. Involuntary blinking should occur every 3-4 secs with complete closure of the lids.

Measurement of ptosis

We diagnose ptosis if the upper lid covers more than 2 mm of the cornea while the patient is looking straight forward (primary position).

We can measure the degree of ptosis by measuring the margin-reflex (M.R.D): this is the distance between the upper lid margin and the corneal light reflex while the patient is looking straight at a distant light source.

If the ptosis is so severe that the upper lid covers more than 1/2 the cornea we will not be able to use the above mentioned method. Instead, we can measure the distance between the upper lid margin and the lower limbus (6.0 o'clock position).

Measurement of the levator function if there is ptosis

This is important to decide the type of ptosis surgery. To measure levator function we follow these steps:

- Tell the patient to look down by moving his eyes only without moving the head.
- Press firmly on the brow to prevent frontalis overaction.
- Hold a ruler before the eyelid while the patient is still in full down gaze (Fig.).
- Ask the patient to gaze fully up (without moving the head) and notice the excurtion of the upper lid margin in mm (normally it is 15-18 mm).

4- Skin of the lids

- Texture:
  - Thin, redundant → blepharochalasis
  - Thick, rough and scaly → myxedema
- Edema:
  - Localized: Stye, boil,hodreolum internum, dacryocystitis.
  - Generalized: Angioneurotic, nephrosis, myxedema, orbital cellulitis.
- Swelling:
  - Palpation for **chalazia**.
  - Malignant tumours: Squamous cell carcinoma, adenocarcinoma.
- Vesicles:
  - Herpes Zoster, Herpes Simplex.

5- Lid margins

- Normal appearance of post. sharp border in apposition to the globe, ant. rounded border with a grey line in between.
  - Rolled out lid margin → **ectropion**
  - Rolled in lid margin → **entropion**
- Presence of scales, dandruff, parasites or nits, ulcers.
- Defects (coloboma): Surgical, congenital.

6- The lashes

- Normally:
  - 100 in the upper lid, 50 in the lower lid.
  - Upper lid → directed forwards and downwards.
  - Lower lid → directed forwards and upwards.
- Abnormalities:
  - Loss of lashes partially or totally → madarosis.
  - Abnormal direction → maldirected.
  - Rubbing lashes → trichiasis.
  - Presence of extra row at the white line → districhiasis.
  - If no abnormalities are detected: Write → normal eyelids.

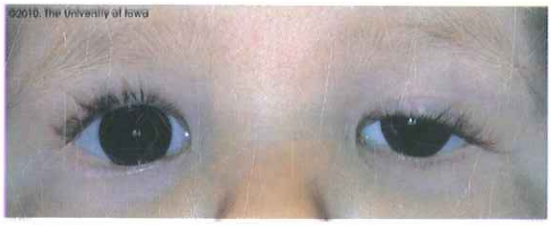


Fig. 2-a: Unilateral congenital ptosis.

Fig. 2-b: Unilateral ptosis in adult

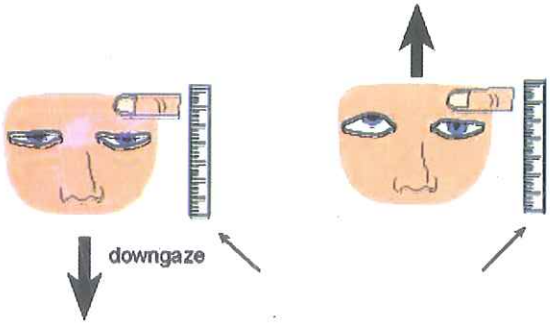


Fig. 2-c: Testing degree of levator action.

Fig. 2-d: First step in levator testing.

Fig. 2-e: Chalasion in lower lid.

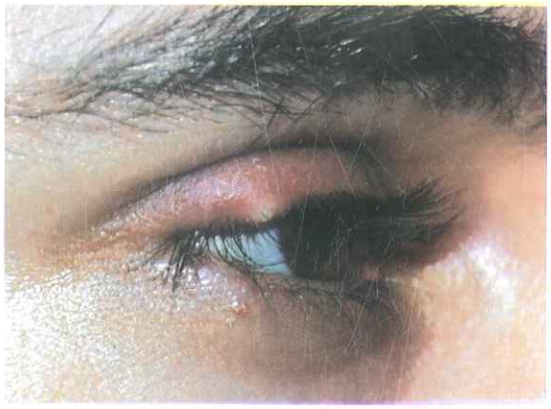


Fig. 2-f: Upper lid stye.

Fig. 2-g: Rt lower lid ectropion.

Fig. 2-h: Lower lid entropion.

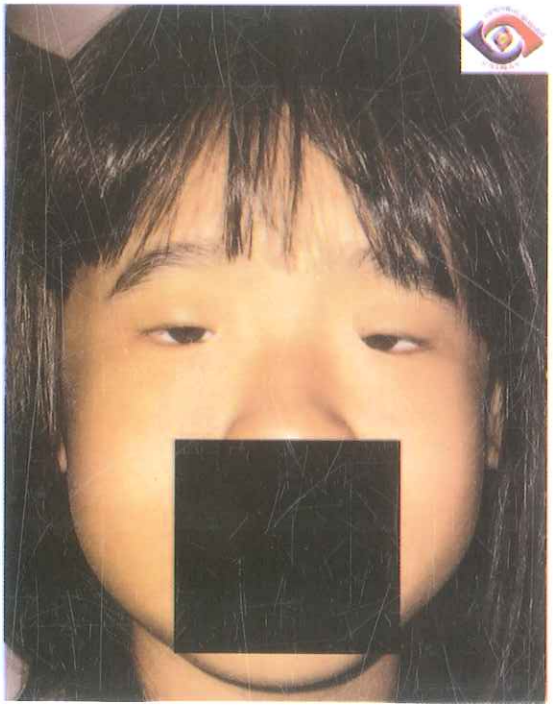


Fig. 2-h2: Ptosis-blepharophimosis.

Fig. 2-i: Upper lid trichiasis.

LACRIMAL SYSTEM

The tear film (pre-corneal) is composed of 3 layers:

- Outer superficial lipid layer secreted by the sebaceous meibomian glands of the tarsal plates and by the glands of Zeis which lie near the lid margins.
- Middle aqueous layer secreted by the main lacrimal gland and the accessory lacrimal glands of:

Wolfring	**and**	**Krause**
In the conjunctiva at the upper margin of the superior tarsal plate		Deep in the conjunctival substantia propria in the superior and inferior fornices

- Inner deep mucoid layer secreted by goblet cells of the conjunctiva.

There is continuous flow of tears. After their secretion they are distributed over the surface of the eye by gravity, capillary action and the movement of the eyelids (blinking). Tears leave the eye by evaporation and by flow through the lacrimal excretory system composed of the puncti, lacrimal sac and the nasolacrimal duct.

So the lacrimal system consists of:

1- Secretory part
2- Excretory part

I- Secretory part

– The main lacrimal gland is responsible for the **reflex secretion** (emotional or due to irritation).
– The accessory lacrimal glands of Wolfring and Krause, they secrete the **basic lacrimal secretion** of the pre-corneal tear film.

The main lacrimal gland

It is palced at the superotemporal quadrant of the orbit. Its palpebral part may be seen as a globulated pink mass under eyelid when the patient is asked to look down and nasally and traction is placed on the upper outer eyelid.

Normally, the lacrimal gland is not felt. If felt: malignancy or chronic granuloma.

1- Testing of the aqueous part (Schirmer's test):

Special filter paper strips which are bent and inserted to be hanged on lower lid margin at the junction of the lateral and middle third. The inner part of the strip is dipped into the lower fornix and the outer part is observed to notice the amount of its wetting by the tears.

Schirmer's test can be done by 3 different methods:

- ***Schirmer's test I:*** Measures the total (basic and reflex) secretion):
  The strip is applied as described above, then record the length of the strip wetting in mm after 5 minutes. Wetting less than 5 mm is a sure diagnosis of dry eye.
  Normally the wetting is 15 mm or more.

- ***Basic secretion test:***
  We do the same test of Schirmer I but after applying topical anaesthetic drops to the conjunctiva to stop reflex secretion.

- ***Schirmer's test II:***
  To measure only reflex secretion: We measure the amount of strip wetting after stimulating the nasal mucosa (either mechanically or using an aromatic odour).

2- Testing the mucin part

It is done by measuring the **Tear breakup time method(BUT):**

- We apply a sterile fluorescein strip to touch the lower tarsal conj.
- We use the slit lamp with diffuse illumination and Cobalt blue light to observe the cornea.
- We measure the time from a complete blink to the appearance of the first dry spot (black spot) on the corneal tear film.
- BUT greater than or equal to 10 seconds is considered normal.

3-Rose Bengal staining

Helps in diagnosing dry eye by staining diseased conjunctival epithelium.

- Apply only a small drop of 1% Rose Bengal: It will stain the conjunctiva in the interpalebral region in the form of 2 triangles with their bases at the limbus.

II- Excretory part

1- **Puncti:** Small openings approximately 0.3 mm in diameter that lie at the edge of each eyelid. They are just touching the globe. Each punctum is about 4 mm temporal to the medial canthal angle among adults, while the lower punctum is slightly more temporal than the upper.

2- **Canaliculi:** Each canaliculus has 2 limbs: a short vertical 2mm long and horizontal limb about 8 mm long. They open in the lacrimal sac.

3- **Lacrimal sac:** Cystic structure lying in the lacrimal fossa. The medial palpebral ligament passes in front of it and Horner's muscle passes behind it.

4- **The nasolacrimal duct:** It is a vertically oritented tube passing downwards, backwards and laterally from the sac through the bony-lacrimal duct to drain into the nose beneath the inferior turbinate via the nasal ostium (Hasner's valve).

Testing tear drainage

This is important in investigating the case if there is epiphora.

Epiphora is watering of the eye due to impaired drainage of tears.

How to examine and investigate the lacrimal drainage system?

It includes:

1- **Examination of the lower lid margin** for good opposition of the patent puncta against the globe. So if there is ectropion or punctral occlusion, this will account for epiphora.

2- Inspecting and palating the lacrimal sac

To notice any sac swelling which may be:

- Soft, cystic → Mucocele.
- Soft and +ve regurge → Chronic dacryocystitis.
- Hard → Neoplasm.

3- Jones tests (dye tests)

Jones test I (fluorescein test)

- A drop of fluorescein is applied to the conjunctiva and a cotton tipped applicator is applied beneath the inferior turbinate.
- If there is no staining of the cotton by fluorescein after 5 minutes then there is element of obstruction and we do the second test:

Jones test II (Lacrimal syringing test)

Using a bent cannula attached to a saline filled syringe we pass the cannula through the lower punctum then 2 mm down then shift horizontally, medially for about 8 mm till you reach the sac (you kick against the bone by the cannula tip) then start injecting saline, while the cotton tipped applicator is placed in the nose as before:

- If there is fluorescein staining of the cotton, then the canaliculi are patent but there is **sac atony or NLD stenosis**,
- If there is wetting of the cotton with saline only without staining: this means patency of NLD, but fluorescein did not pass from the eye to the sac i.e. **canalicular stenosis.**
- If there is no wetting or staining of the cotton, then there is complete **NLD obstruction.** In this case, saline will come back only from the upper punctrum.

4- Dacryocystography (DCG)

- The punctra are intubated using polyethylene tubing so that the X-ray specialist hands are not in the X-ray field, a radioopaque material is injected into the sac. Serial films are taken using macro-photography and digital subtraction. This helps to diagnose level of obstruction.

Fig.3-a: Shirmer test for dry eye.

Fig. 3-b: Shirmer test.

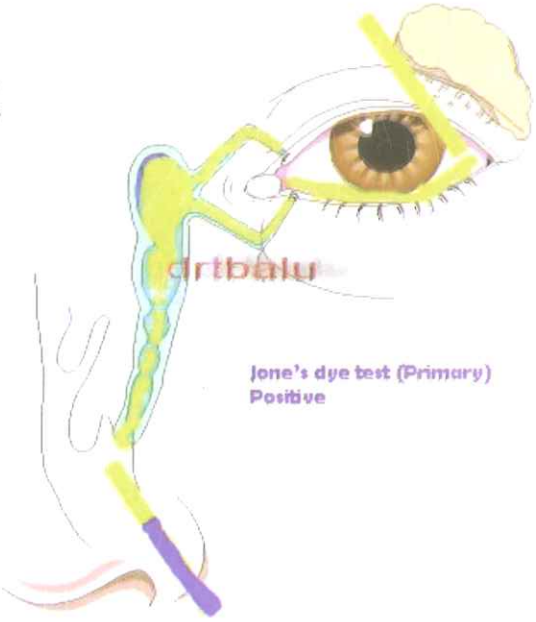


Fig. 3-c: Jones I test for epiphora.

Fig. 3-d: Jones II test.

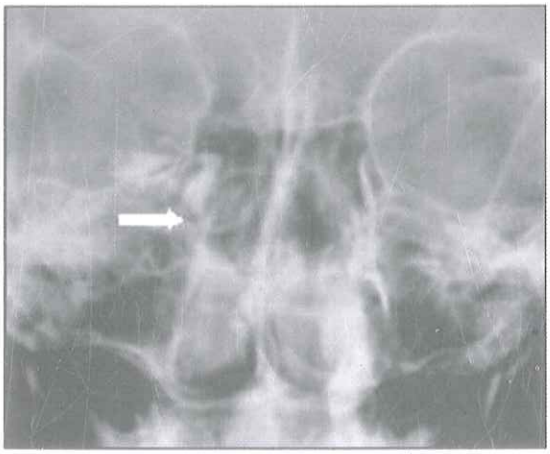


Fig. 3-e: Dacryocystography.

Fig. 3-f: Dacryocystitis.

EXTRAOCULAR MUSCLES AND STRABISMUS

- Testing individual uniocular eye movement (each eye separately) is called **ductions.**

  In case of certain muscle **paralysis**, there is marked limitation of movement of the eye in the direction of action of the paralysed muscle. But is there is only muscle **paresis(palsy)** there is partial limitation i.e. the eye can pass the midline but is not able to reach extreme gaze.
- Testing binocular movements in the same direction is called **versions** (conjugate movements).

It helps in:

- Discovering conjugate gaze palsy e.g. horizontal gaze or vertical gaze which are significant in diagnosing some central lesions.
- Diagnosis or overaction or underaction of a muscle in relation to its contralateral synergist.

Examination of a case of squint

When examining a case of squint we should answer the following questions by the clinical tests as follows in the same sequence:

1- Corneal light reflex test	- Is it a case of manifest squint? - It is divergent or convergent? - What is the angle of deviation?
2- Testing extraocular muscle motility	- Is the squint paralytic or concomitant?
3- Cover test	- If concomitant, is it unilateral or alternating? - Is there eccentric fixation, amblyopia or suppression?

1- Corneal light reflex test (Hirschberg test):

- On doing the corneal light reflex test, the source of light and the eyes of the examiner should be central in relation to the eyes of the patient, so the angulation of light to the patient's eyes is central and equal.

Significance of the test is to answer the first 3 questions as follows:

- If the patient has manifest squint: The light reflex appears central in one eye and deviated to one side (eccentric) in the other eye.
- If it is convergent squint the light reflex is deviated temporal to the center (because the eye is deviated nasally) and vice versa.
- The angle of deviation (rough estimation)
  We observe the exact site of the corneal light reflex on the squinting eye:
  a- If it lies on the papillary border so angle is 15°.
  If on the limbus, angle is 45°.
  If midway between the pupillary border and the limbus, angle = 30°.
  b- Each mm deviation of the corneal light reflex from the center = 7.5° of deviation, i.e. if the corneal light reflex is on limbus, this means that it is deviated 1/2 the horizontal diameter of the cornea i.e. 6 mm. So, the angle = $6 \times 7.5° = 45°$.

N.B.: More accurate methods of testing the angle of deviation:

- Prism and cover test.
- Synoptophore.

2- Testing extraocular muscle motility

- If the muscles are freely mobile in all direction of the gaze → this is a case of concomitant squint.
- If there is limitation in one direction or more → paralytic, and this is the direction of action of the paralysed muscle.

3- Cover test

- We have 4 different types of cover test:
  1- Cover test.
  2- Cover-uncover test.
  3- Alternate cover test.
  4- Prism and cover test.

- In all these 4 types we always start by corneal light reflex test and cover the fixing eye, then:

1- ***In cover test:*** we observe the squinting eye behviour.

- If it moves to pick up fixation we notice direction of movement: if it moves temporally to fixate → convergent squint and vice versa. So, heterotropia is diagnosed.
- If it did not move and remained squinting (inspite of covering the normal fixing eye), so there is eccentric fixation.

2- ***In cover-uncover test:*** we observe the covered eye after removing the cover .

- If it shows movement to fixate again,(i.e. it was deviating only under the cover), so this eye has is the fixing eye and the heterotropia is unilateral.
- If the covered eye remains deviated after removing the cover, an alternating heterotropia is present.

3- ***In alternate cover test:*** we do this test to diagnose latent squint (heterophoria) if no manifest squint (heterotropia) was detected on the cover-uncover test. One eye is covered for 2 seconds then the cover is quickly shifted to the other eye. We should note any movement of the uncovered eye.

- If no movement is noted, the patient is orthophoric (normal).
- If the eye moves nasally to fix, so it is exophoric. If it moves temporally, the eye is esophoric, and so on.

4- ***In prism-cover test :***

- This test helps in accurate measuring of the angle of deviation in prism diopters (2 prism diopters = one degree of deviation).
- We place prisms of increasing power in front of the squinting eye until on covering the fixing eye, the squinting eye does not move to up pick fixation.

  N.B: We put the prism with apex in, if the squint is convergent and vice versa) the power of the used prism = angle of deviation in prism diopters.

A last question to answer in case of squint: Is it primary, secondary or consecutive

- ***Primary:*** The squint is the only ocular disease.
- ***Secondary:*** The squint is secondary to another ocular disease unilaterally interfering with vision e.g. corneal opacity, cataract, refractive error, retinal or optic nerve disease.
- ***Consecutive:*** Following surgery (iatrogenic).

In addition, in all cases of squint we examine the following:

A- Visual acuity (both unaided and corrected): this will help to know:
- Whether the squinting eye is amblyopic or not.
- Whether the concomitant squint is alternating (if visual acuity is nearly equal in both eyes) or unilateral (if the visual acuity in one eye is markedly weaker than the other eye).

B- Refraction: The type of refractive error if present will explain the type of squint e.g. high hyperopia in a child may cause accommodative esotropia which might be treated with glasses.

C- Fundus examination: To exclude any retinal lesion which may be the cause of squint e.g. retinoblastoma or unilateral optic atrophy.

CONJUNCTIVA

Anatomy

It is formed of the following parts:

- Palpebral conjunctiva: Which is divided into zones:
  1- Marginal: from the lid margin to the sulcus substralis.
  2- Tarsal: adherent to the tarsus.
  3- Orbital: from the border of the tarsus to the fornix.
- Conjunctiva of the fornices (upper and lower).
- Bulbar conjunctiva: from the fornices to the limbus (the nearest 3 mm to the limbus are adherent to the underlying tissue and are called limbal conjunctiva).

Fig. 4-a: Left esotropia.

Fig. 4-b: Left exotropia.

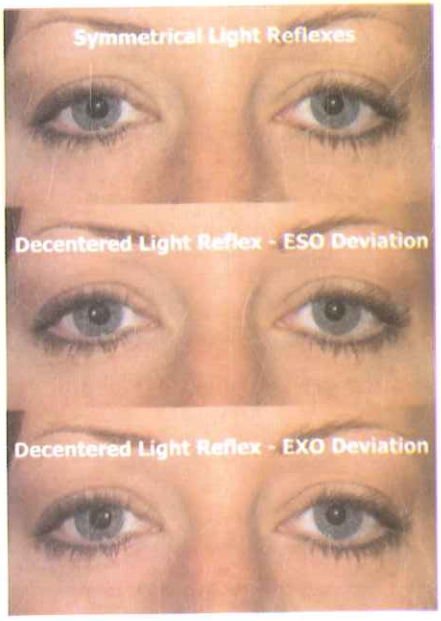


Fig. 4-c: Corneal reflex test.

Fig. 4-d: Cover test.

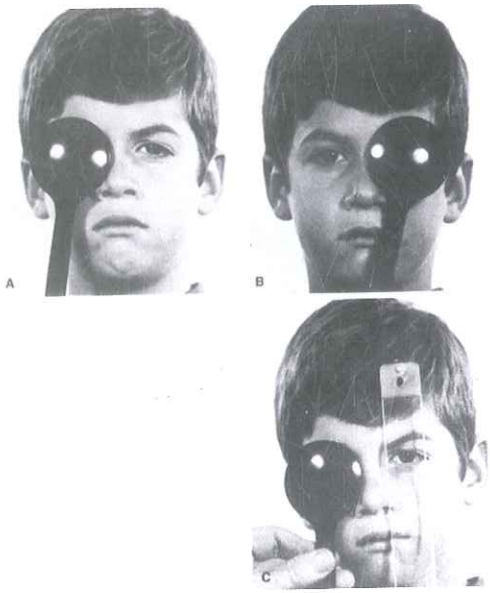


Fig. 4-e: Prism and cover test.

Examination:

Bulbar conjunctiva may be easily examined by separating the two lids apart.

Palpebral conjunctiva can only be examined by everting the lid.

The lower lid is everted by sharply pulling down its skin while the patient is looking up. This also visualizes the lower conjunctival fornix. The upper lid is everted by the following method: the examiner grasps the upper eyelashes between his index and thumb and pulls the eyelid forwards away from the eyeball, at the same time, the thumb of the other hand is placed on the skin of the upper lid at the level of the upper border of the tarsus, exerting gentle pressure backwards and downwards. The lid margin is then pulled upwards.

This method does not visualize the upper fornix which can be examined by everting the upper lid using Desmarre's lid retractor.

Important clinical signs and lesions

1- Hyperaemia: 2 types

	Conjunctival	Ciliary
Site	Conjunctival vessels are congested leaving a relatively white zone around the cornea	Hyperaemia is most marked around the cornea (circum-corneal)
Vessels	Move freely with movement of the conjunctiva	No movement with the conjunctiva
Colour	Bright red	Purple
Pressure effect	Blanch with pressure then refill slowly	Blanch with pressure, refill rapidly
Sympatho-mimetics	Blanching effect	No effect
Caused by	Conjunctivitis	Keratitis Iridocyclitis Acute or subacute glaucoma

2- Discharge of various types may be seen with conjunctivitis

*a- **Mucous or mucopurulent discharge:*** Which gums the lids together, particularly in the morning. This occurs with mucopurulent conjunctivitis which is diagnosed by:

- Hyperaemia most marked at the lower fornix.
- May be flakes of mucopus in the lower fornix.

*b- **Purulent discharge (pus):*** Occurs with purulent conjunctivitis, which is diagnosed also by:

- Marked lid oedema, chemosis.
- Enlarged preauricular lymph nodes.

*c- **Serosanguinous (blood tinged tearing):*** Occurs with membranous conjunctivitis.

*d- **Sticky or ropy discharge:*** Occurs with spring catarrh.

3- Other infective conjunctivitis

*a- **Trachoma***

- ***Follicles:*** Rounded greyish, dome shaped lesions scattered on tarsal conjunctiva of upper lid.
  - If small <1 mm: Immature follicles.
  - If larger and expressible: mature follicles.
- ***Pannus:*** Lymphocyte infiltration with superficial vascularization of the margin of the cornea limited to the upper half.

*b- **Viral conjunctivitis***

shows acute diffuse hyperaemia, lid oedema, follicles on lower palpebral conjunctiva and in some cases punctuate keratitis.

4- Allergic conjunctivitis

*a- **Spring catarrh (exogenous allergy):*** more in children

- ***Bulbar type:*** Gelatinous thickening of the limbus associated with localized conjunctival injection (mostly in the interpalpebral zone).
- ***Palpebral type:***large flat topped papillae with cobble-stone arrangement (on the palpebral conjunctiva of the upper lid).

Fig. 5-a: Purulent conjunctivitis.

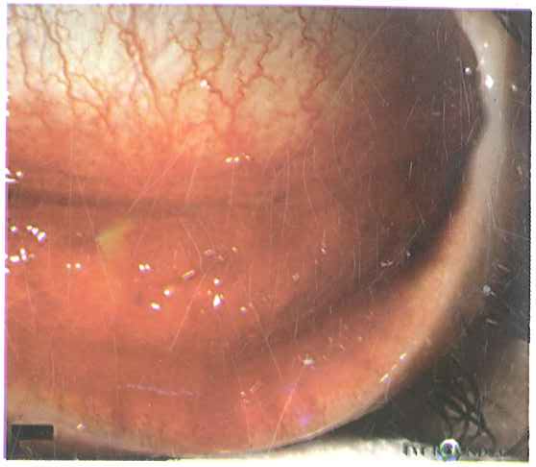


Fig. 5-b: Follicular conjunctivitis.

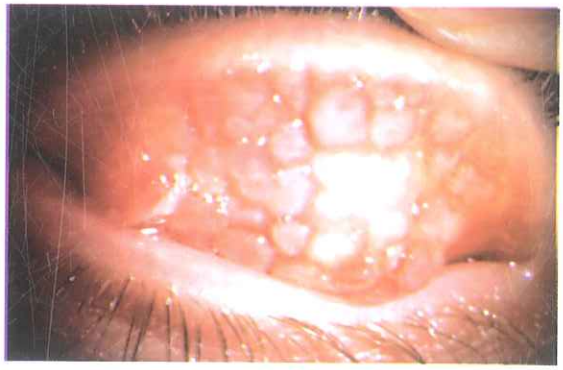


Fig. 5-c: Papillae of spring catarrh.

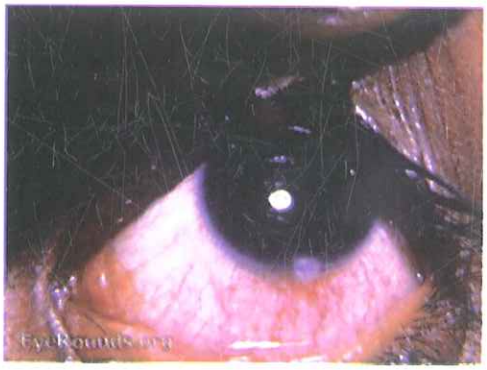


Fig. 5-d: Limbal phlycten

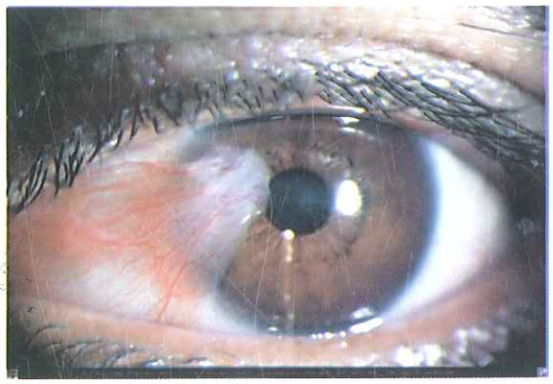


Fig. 5-e: Large pterygium.

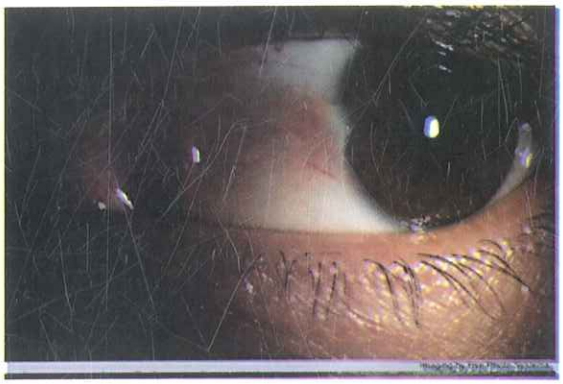


Fig. 5-f: Small pterygium.

Fig. 5-g: Pingueculae.

Fig. 5-h: Conjunctival injection.

b- Phlyctenular conjunctivitis (endogenous allergy)

- The basic lesion is phlycten : usually in children, it shows as:
  - Yellowish nodule, associated with localized injection.
  - Limbal or conjunctival.
  - Single or multiple.
  - Commonly ulcerates.
  - Not painful or tender.

5- Conjunctival degenerations

- ***Pterygium:*** Triangular fibrovascular fold arising from sunconjunctival tissue, encroaching on the cornea.
- ***Pinguicula:*** Triangular fatty fold with base towards the cornea, apex nasal.
- ***Bitot spots:*** Foamy white areas of kertinized epithelium due to xerosis (dryness).

CORNEA

- The cornea forms the anterior 1/6 of the outer coat of the globe.
  It fits into the sclera as a watch glass.
- The primary physiologic function of the cornea is to maintain an optically smooth surface and a transparent medium while protecting the intraocular contents of the eye.

  It is transparent except the peripheral 1 mm at the limbus. The transparency of the cornea is due to:

  1- Uniformity of the refractive indices of epithelium, endothelium and descemet's membrane.
  2- Special arrangement of stromal fibrils.
  3- Absence of the blood vessels except in the peripheral 1 mm.
  4- The active metabolic pump of endothelium which prevents corneal oedema.
  5- Non myelination of the corneal nerve fibers.

The following points are to be noted when examining the cornea:

1- Diameter

- The horizontal diameter of the cornea (11.6 mm) is longer than the vertical diameter (10.6 mm).
- If the corneal diameter is greater than 12.5 mm, it is called "**megalo cornea**".

2- Curvature

- Normally the anterior surface of the cornea forms part of a sphere whose radius of curvature is 7.8 mm. This could be measured by "Keratometer".

3- Brightness

- Impaired luster is usually obvious in any form of keratitis.

4- Irregularity of surface

- Assessment of the corneal surface may be by "Placido keratoscopic disc" on which are painted alternating black and white circles. The observer looks through a hole in the centre at the corneal image, as reflected from a light behind the patient.
- A loss in the sharpness of the outline of the image denotes a loss of the normal polish of the corneal surface, while irregularities in the ring denotes irregularities of the corneal surface.
- The presence of a pathological state such as gross scaring or early keratoconus leads to deformity of the corneal rings.

5- Opacity

- Corneal opacities may interfere with vision directly and/or indirectly by producing irregular astigmatism.

The opacity may be:

a- Nebula:

If the corneal scar is thin and the resulting opacity is slight with ill defined borders. If it is more dense it is sometimes called **macula**.

If the scar is very dense and white it is called a leucoma. If the iris is incarcerated in this **leucoma**, it is called **leucoma adherent.**

– A thin diffuse nebula covering the papillary area interferes more with vision than a localized dense leucoma covering part of the papillary area.

The reason is that the leucoma stops all the light which falls upon it, whereas the nebula refracts it irregularly. So, the image formed is markedly blurred.

b- Arcus senilis

It is annular infiltration of the periphery of the corneal stroma with lipoidal material, separated from the limbus by a clear interval (Lucid interval of Vogt).

c- Band shaped opacity(band keratopathy)

A horizontal opacity occurs across the cornea. It is due to hyaline degeneration of the cornea followed by deposition of calcium.

d- Keratectasia:

Protrusion of corneal scar without iris incarceration.

6- Corneal vascularisation

- Normally the cornea is avascular except the peripheral 1 mm.
- Superficial vessels in the cornea are distinguished from deep vessels by the following features

Superficial corneal vessels	Deep corneal vessels
- Can be traced over the limbus into the conjunctiva - Bright red and well-defined - Branch dichotomously in an arborescent fashion	- Seen to come to an end at the limbus - Greyish red and ill defined or only diffuse red bluish - Run more or less parallel to each other and branch at an acute angle

Pannus: Means cellular infiltration together with superficial vascularisation of the previously clear cornea.

7- **Corneal sensitivity:**

To determine corneal sensitivity the cornea is lightly touched with a wisp of cotton drawn out to a few threads while the lids are held apart. The approach should be from the side so that the patient does not see the cotton tip coming towards him and reflexly close his eye. One more accurate measurement of corneal sensitivity may be made with the **Cochet-Bonet aesthesiometer.**

Testing corneal sensitivity is of diagnostic significance in certain cases e.g. herpes, fifth nerve lesions, absolute glaucoma, superior orbital fissure and orbital apex syndromes.These diseases cause decrease or loss of corneal sensation.

7- Corneal staining

To determine the state of the corneal epithelium, the technique of corneal staining with a vital dye should be employed. Three dyes are usually employed:

a- ***Fluorescein*** is the most useful to delineate areas denuded of epithelium (abrasions, multiple erosions, ulcers). A drop of 2% fluorescein is instilled in the eye and excess dye is washed off with saline. The stroma is stained green because of the absence of epithelium in corneal ulcers. The herpetic ulcers are either punctuate or more classically dendritic.

b- ***Rose Bengal*** stains diseased and devitalized cells with red colour (as superficial puntate keratitis and herpetic kreatitis) .

c- ***Alcian blue stains*** mucus selectively.

8- The corneal endothelium

It is examined by the specular microscope which makes it possible to observe a relatively large number of endothelial cells, photograph them.

The average cell count is 2800 cells per square millimeter. The major function of the endothelium is the maintenance of proper corneal hydration. Impaired pump function can occur in injury (postsurgical or traumatic) and in some inflammatory conditions.

Fig. 6-a: Rt megalocornea with opacity.

Fig. 6-b: Band keratopathy.

Fig. 6-c: Corneal pannus.

Fig. 6-d: Leucoma adherent

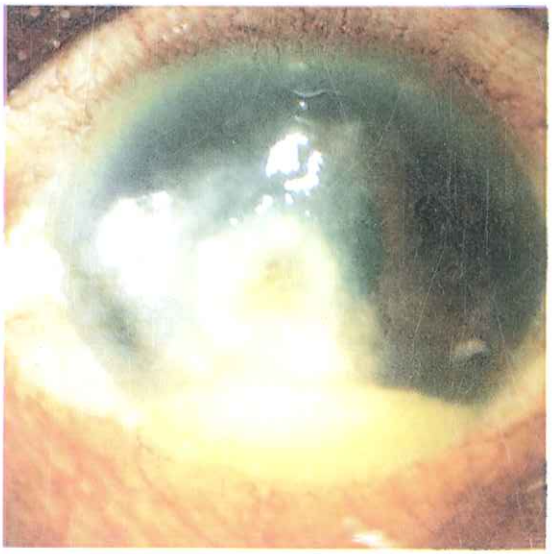


Fig. 6-e: Hypopyon corneal ulcer.

Fig. 6- Herpetic dendritic ulcer.

Fig. 6-g: Keratoconus.

Fig. 6-h: Keratoconus, Munson's sign.

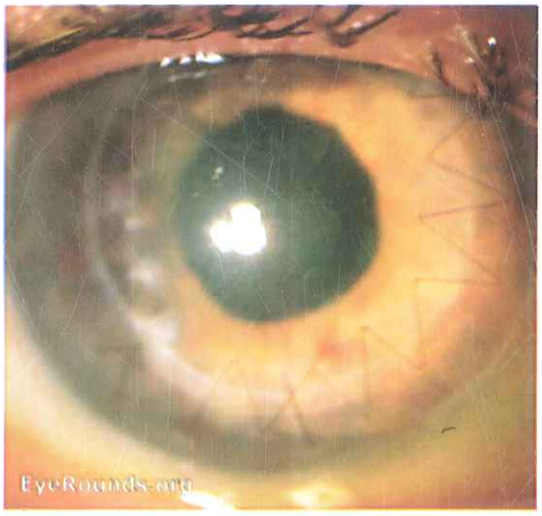


Fig. 6-i: Penetrating keratoplasty.

9- Keratic precipitates (K.P.s)

In the form of small accumulation of inflammatory cells which adhere to the endothelium and are derived from the uveal tract in cases of anterior uveitis. These can best be studied with slit lamp.

SCLERA

The sclera is the dense fibrous outermost coat of the eyeball.

It is avascular and white in colour. The most important clinical affections of the sclera and episclera are inflammatory.

a- Colour

- The sclera may look pearly-white in pernicious anaemia.
- Blue colouration of the sclera may be due to a herniation of uveal tissue owing to weakness of the sclera (staphyloma) or to increased intraocular pressure, buphthalmos, high myopia and in some connective tissue diseases.

b- Patches of inflammation

- They show up as prominent congested nodules with localised intense conjunctival injection around them.

Episcleritis

Characterised by the presence of a small nodule, 2-3 mm from the limbus, tender, fixed to the sclera and the conjunctiva can be moved over it(D.D from conj. phlycten).

Scleritis

Inflammation of all layers of the sclera. It may be diffuse or nodular. The nodules are larger than those of episcleritis and less defined. Usually associated with uveitis.

Staphyloma

It is an ectasia of the outer coat of the eye in which a part of the uvea is incarcerated.

a- **Corneal staphyloma:** Ectatic scar in the cornea in which the iris is incarcerated.

b- **Scleral staphyloma:**
- ***Intracalary:*** Lined by the iris root.
- ***Ciliary:*** Lined by ciliary body.
- ***Equatorial:*** Lined by **the choroid.**
- ***Posterior:*** Occurs in the posterior pole, usually in high myopia.

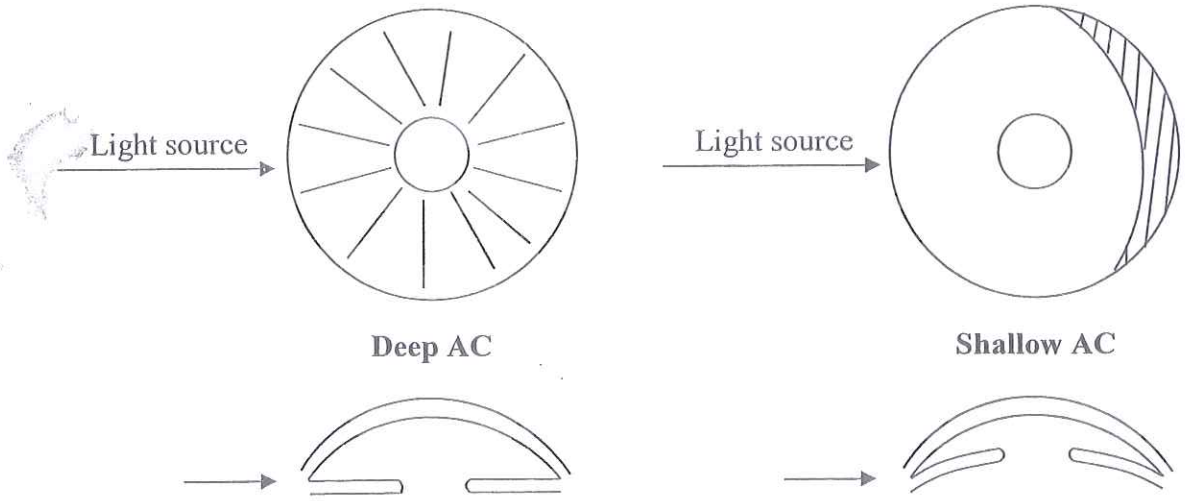
ANTERIOR CHAMBER

The anterior chamber (AC) is shallow in extreme youth and in old age; at other periods of life it is normally about 2.5 mm deep.

The depth of the anterior chamber is estimated by the position of the iris.

Anterior chamber depth assessment

When the AC is shallow, the iris becomes convex as it becomes bowed over the lens. In this condition the nasal iris is seen in shadow when light is directed from the opposite side (Fig.). As the shallowness of the AC increases, the shaded view of the nasal iris increases.



The following points should be noted:

A- Depth

- ***The anterior chamber is usually shallow in:***
  1- Angle closure glaucoma.
  2- Pupillary block glaucoma.
  3- Intumescent cataract.
  4- Choroidal detachment.
  5- Perforated corneal ulcer.
  6- Hypermetropia.

- ***The anterior chamber is abnormally deep in:***
  1- Congential glaucoma (Buphthalmos).
  2- Aphakia.
  3- Keratoconus.
  4- High myopia.
  5- Posterior dislocation of the lens.

N.B.

- When the iris is bowed forwards (iris bombé) AC is funnel-shaped, the centre being deep, the periphery shallow.
- Tilting (sublaxation) of the lens causes AC to be deeper on one side than on the other as does angle recession following trauma.

B- Content

- In inflammatory conditions of the uveal tract when the permeability of the vessels is increased, the aqueous may contain particles of protein or floating cells. These are of considerable diagnostic importance.

1- Aqueous flare

- In inflammation of uveal tract albuminous exudates escape in the anterior chamber, particularly if the ciliary body is involved, the aqueous becomes plasmoid.

- The anterior chamber becomes hazy forming flare which may be visible with the slit lamp when its beam is focused to a point.
  This turbidity interferes with a clear view of the iris and is easily mistaken for haziness of the cornea.

2- Cells

- In inflammation of the uveal tract, the aqueous contains leucocytes.

3- Keratic precipitates (K.Ps.):

- The most characteristic sign of the cyclitis is the presence of keratic precipitates sticking to the posterior surface of the cornea. They consist of leucocytes and cellular debris adhering to the corneal endothelium.

K.Ps. are usually arranged in triangular pattern on the lower part of the cornea with the apex toward the pupil, due to the effect of gravity and convection currents of the aqueous with the fine K.Ps. up and the big K.Ps. down.

The old K.Ps. are crenated and pigmented, while new K.Ps are white.

4- Hypopyon

- In infected wounds and ulcers of the cornea and occasionally in iridocyclitis, there is pus in the anterior chamber forming a sediment at bottom.

5- Hyphaema

- Collection of blood in the anterior chamber may occur after contusions or spontaneously.

THE IRIS

1- **The colour of the iris** and the clarity of its pattern should first be noted. The two irides or parts of the same iris may be different in colour, conditions which are known respectively as heterochromia iridis.

Fig. 7-a: Hyphema.

Fig. 7-b: Keratic perciptates (K.Ps).

A grey iris with an ill-defined pattern suggests atrophy from cyclitis and patches of atrophy suggest glaucoma. Darkly pigmented spots in the iris, not raised above the surface as known as "Frechles".

2- **Patterns:** Indistinctiveness of the pattern of the iris is caused by inflammatory exudates.

This is known as "Muddiness of the iris".

The iris loses its normal pattern, colour and luster due to exudation of inflammatory cells within the tissues of the iris and to the formation of a thin film of exudates on the surface of the iris. A muddy iris, with small irregular pupil and a sluggish reaction to light is indicative of iritis.

3- **Adhesions:** Special attention should be paid to any adhesions (synechia), anterior (to the cornea) or posterior (to the lens capsule). The exudates in the posterior chamber may glue the iris to the anterior lens capsule in the papillary area forming posterior synechiae (Fig. 1.31). So, the pupil appears crenated or festooned after instillation of mydriatic.

Annular posterior synechiae fix the whole papillary margin to the anterior lens capsule and lead to the formation of seclusio-pupillae.

If seclusion of the pupil is unrelieved the aqueous being unable to pass forwards into the anterior chamber it will distend the posterior chamber so that iris becomes ballooned forwards (iris bombe).

The iris root may also become adherent to the corneal endothelium at the limbus by bands of organised exudates forming peripheral anterior synechiae which are best seen by gonioscopy.

4- **Tremulousness** of the iris (iridodonesis) is seen when the eyes are moved rapidly if this tissue is not properly supported by the lens. This occurs in absence, shrinkage or sublaxation of the lens. The phenomenon is best seen in a dark room with oblique illumination.

5- **Defect in the iris:**

- ***Iridectomy:*** Part of the iris removed by an operation. There are different types: peripheral, visual, keyhole and wide basal.
- ***Iridodialysis:*** The iris is torn from its ciliary attachment due to blunt ***trauma***.
- ***Congenital coloboma:*** This is a developmental pear-shaped defect in the iris, usually present downwards and inwards. It arises from an imperfect closure of the foetal cleft. It is usually associated with coloboma of the choroid.

6- **Lesions:** e.g. Tuberculoma, gumma, malignant melanoma.

7- **New vessels on the iris surface:**
New vessels (rubeosis iridis) occur in cases of diabetes mellitus and central retinal vein occlusion. These new vessels block the angle of the anterior chamber leading to secondary glaucoma.

Congenital aniridia

This is a congenital condition in which the iris fails to develop. It is usually accompanied by nystagmus. The condition usually induces glaucoma (Why?).

EXAMINATION OF THE PUPILS

Normal pupils are perfectly round and are always equal in size and constricts visibly in the light and during accommodation → normal sized, rounded and reactive.

You should examine both for the static and dynamic conditions of the pupils.

I- Static conditions

1- Number

Normally: There is one pupil.

Fig. 8-a: Posterior synechiae & K.Ps.

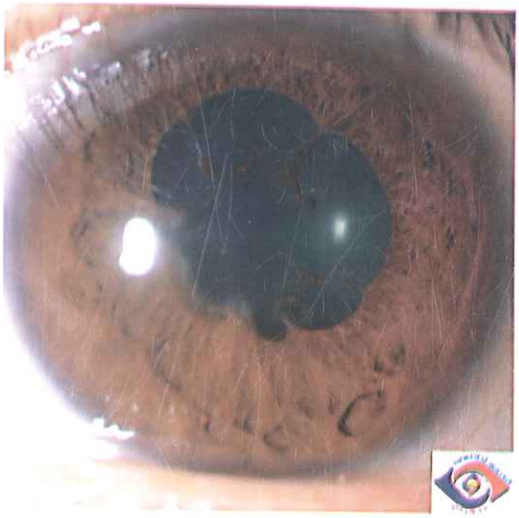


Fig. 8-b: Posterior synechiae.

Fig. 8-c: Granulomatous iridocyclitis.

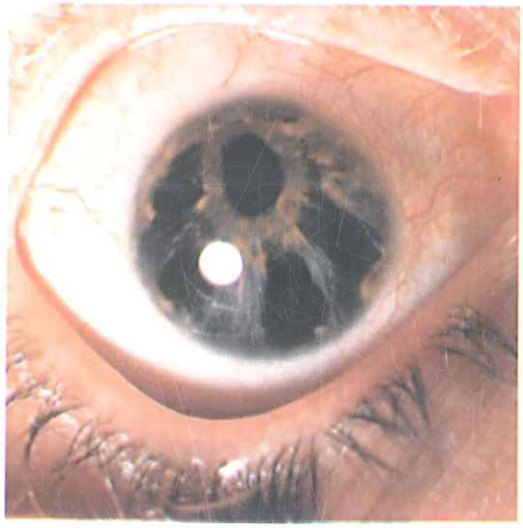


Fig. 8-d: Iris atrophy.

Fig. 8-e: Rubeosis iridis.

Variations:

- Absent pupil (closed in iridocyclitis).
- Two pupils (presence of large peripheral iridectomy or iridodialysis).
- Multiple pupils: Pseudopolycoria (as in essential iris atrophy) .

2- Position

Normally: It is slightly eccentric to the nasal side to help reading.

Variations:

- Is called corectopia.
- May be:
  - Drawn up as in vitreous loss.
  - Drawn to one side as in leukoma adherent.

3- Shape

Normally: It is rounded.

Variations:

- Vertically Oval pupil as in acute angle closure glaucoma.
- D-shaped pupil as in iridodialysis.

4-Margin

Normally: It is regular.

The margin may be irregular in cases of:

- Festooned pupil of chronic iritis(due to posterior synechiae).
- Defects as in surgical or congenital coloboma.
- Tears of the margins(caused by blunt trauma).
- Ectropion uveae as in neovascular glaucoma.

4- Size

Normally: The size ranges from 3-5 mm in room light..

- If <3 mm: It is a miotic pupil.
- If >7 mm: It is a mydriatic pupil.
- The pupil may be relatively dilated but reactive in myopia and nervous excitement.

- It may be small in babies and old ages.

– Both pupils should have an equal size.
– A difference in the size of both pupils is called anisocoria as in cases of unilateral dilated or constricted pupil.

Pupil dilatation may be due to:

1- Physiologic (with normal reactivity) in myopia and nervous excitement, and in dim light (dark reflex).
2- Pharmacologic: by mydriatic medicines e.g.
   a- Parasympatholytics: atropine and cyclopentolate : cause also accommodation paralysis.
   b- Sympathomimetic e.g. phenylephrine, adrenaline: with no effect on accommodation.
3- Pathologic: Retinal detachment, optic atrophy or optic neuropathy, 3rd nerve palsy, and acute attack of angle closure glaucoma.

Small immobile pupil

- Suggests the use of drug, either locally miotics, or systemically: morphia.
- Old iritis with posterior synechia.
- Small sluggish pupil with muddy iris→ active iritis.
- Horner syndrome.
- Bilaterally small pupils may be due to oculomotor nerve irritation or it may be due to palsy of the sympathetic supply as in pontine haemorrhage.

II- Dynamic conditions

1- Reaction to light

N.B. Light is brought from the side in a semidark room while looking to a distant object.

- Direct reaction to light refers to constriction of the pupil receiving increased illumination.
- Constriction of the opposite pupil (even though no light stimulus strikes this opposite eye) is termed consensual pupil reaction.

- Either optic nerve may transmit the afferent part of the pupillary light reflex. Efferent part of the reflex is carried to both eyes via oculomotor nerves.
- In monocular blindness as with a severed or diseased optic nerve, the affected eye will have no direct pupil response but reacts consensually to stimulation of the opposite eye.
- Stimulation of the blind eye, however, will not cause consensual reaction of the opposite normal eye.

  If one eye is claimed to be blind, the pupillary light reflexes will provide valuable objective confirmation or exclusion of this status.

The swinging flashlight test

Discloses differences in afferent visual stimuli between the 2 eyes. Examining in a semi dark room, move the light rapidly from one eye to the other, you seek a dilation of the pupil on which the light newly shines. The meaning of such a paradoxical finding is that the affected eye has a serious receptor or afferent nerve transmission defect **(optic neuropathy)**.

Normal miosis has occurred because of the consensual pupil reaction, while the opposite normal eye is illuminated. However, the direct pupil reaction of the affected eye is weaker than the consensual reaction; hence both pupils dilate when the flashlight moves from the good eye to the affected eye.

This paradoxical dilation is termed Marcus-Gunns pupil. Even a dense cataract will not cause this type of abnormal pupil response.

2- Near reaction (near reflex)

It is determined by asking the patient to look to the far end of the room. While he does so the index finger is suddenly held up vertically at about 6 inches from the patient's nose and he is told to look at it. The movement of the pupils is studied while he converges for the finger.

It is a synkinesis involving **three components:**

- ***Convergence:*** To let pictures fall on corresponding points of the retina.
- ***Accommodation:*** To focus the image on the retina.
- ***Miosis:*** to increase the depth of focus.

THE LENS

Gross anatomy

It is an avascular biconvex disc of gelatinous transparent substance contained within an elastic transparent capsule. It is suspended between the iris anteriorly and the vitreous posteriorly. It is maintained in position within the eye by the suspensory ligament (zonule of Zinn) which is attached to inner surface and processes of the ciliary body and attached to the lens at the equator mainly. It is separated from the iris by a space called the posterior chamber.

Layers of the lens (Slit lamp examination)

It is formed of the following layers:

- **Capsule:** Elastic transparent membrane, thicker anteriorly than posteriorly, thickest at the anterior surface near the equator.
- **Lens fibres:** Include
  - Cortex (outer zone)
  - Nucleus (inner zone) includes 4 areas from the centre to the periphery:
    1- Embryonic nucleus.
    2- Foetal nucleus.
    3- Infantile nucleus.
    4- Adult nucleus.

The lens fibres show lines of fusion that are Y shaped (erect anteriorly, inverted posteriorly).

Functions of the lens

- Accommodation
- It is an important refractive medium of the eye.

Methods of examination of the lens

1- Inspection aided by focal illumination.
2- Slit lamp.
3- Ophthalmoscope

1- Value of focal illumination

A- To examine colour of the pupillary zone:

When light is concentrated on the pupillary zone in a young person the pupil appears black. In an old person the pupil may appear slightly grey as if the patient has cataract, but examination with the ophthalmoscope shows a bright red reflex. This is called **senile sclerosis**. The cause is increased refractive index of the lens with age, this leads to scattering of light from its surface, i.e. some rays are reflected from the lens to the eye of the examiner.

B- By oblique illumination we can see 3 images of the point source of light, called the **Purkinje images**, by holding the light with an oblique angle with the surface of the cornea.

These 3 images include:

- ***The first:*** a bright (erect virtual) image from the convex anterior surface of the cornea.
- ***The second:*** a less bright (erect virtual) image from the convex anterior surface of the lens.
  Both the first and the second images move in the direction of light movement.
- ***The third:*** a small (real inverted) image from the posterior concave surface of the lens (Moves against light movement).

These images help in the diagnosis, for example:

- Presence of 3 images indicates a more or less clear lens.
- Presence of 2 images (1^{st} and 2^{nd}) indicates immature cataract, i.e. there is a still clear zone of the lens behind the anterior capsule.
- Presence of the first image only, indicates either:
  - Absence of the lens (aphakia) or
  - Total lens opacity e.g. mature senile cataract.

C- Lens opacities are seen by oblique illumination as greyish, whitish, yellowish or brownish colour in the pupillary zone.

2- Slit lamp examination to localise the lens opacity

The pupil is better dilated. The different zones of the lens can be examined in full details.

- So the **opacities are better localised** by using the slit lamp, e.g. anterior polar, posterior polar, zonular, nuclear, posterior subcapsular.
- Changes in the lens position even not so evident, can be diagnosed by slit lamp, e.g. sublaxation.
- Ruptures in lens capsule even if minute can be seen.

3- Ophthalmoscopic examination (to detect any opacities in the red reflex)

- Lens opacities appear black by retro-illumination with the ophthalmoscope. We may be able to diagnose the various froms of cataract by the distribution and nature of these opacities, for example:
  - A central opacity may be anterior polar, posterior polar, nuclear, or posterior subcapsular.
  - Peripheral triangular spokes of opacity with their apices towards the centre indicate incipient stage of senile cortical cataract.
  - A white appearance over the whole papillary area suggests a total cataract.
  - If red reflex is bright all through,there is no cataract. So, the sure sign of cataract is detected lens opacity by the red reflex

INTRAOCULAR PRESSURE

Methods of measurement

Rough method: Digital

Accurate method: Tonometers

a- Indentation tonometer.

b- Applanation tonometer.

Normal values

- The normal range is 10-21mm Hg.
- Mean value:

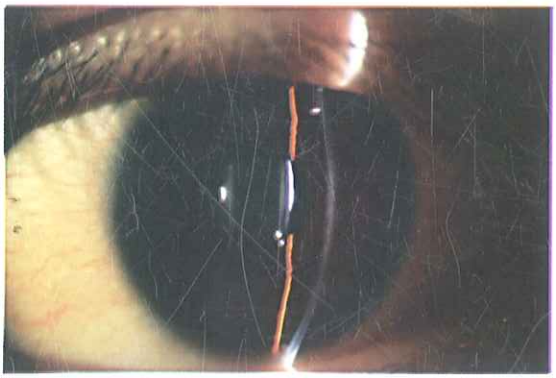


Fig. 9-a: Slit Lamp view of anterior segment.

Fig. 9-b: Mature-hyper mature cataract.

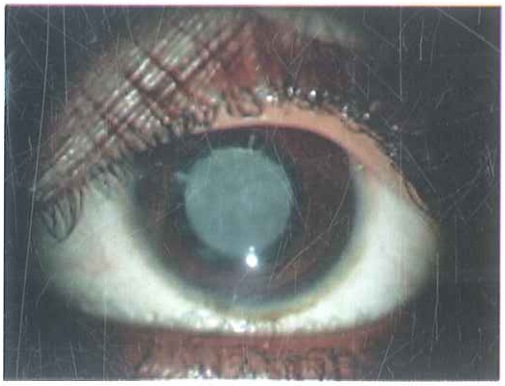


Fig. 9-c: Zonular cataract.

Fig. 9-d: Subluxated lens.

- By applanation:
  * Sitting 15.4 mm Hg.
  * Reclining 16.5 mm Hg.
- By indentation:
  * 16 mm

Digital method

The patient is directed to look downwards and keep both eyes fixed. The two index fingers are then placed on the upper lid above the level of the tarsus while the rest fingers are resting on the forehead and the temple of the patient, then test the tension of the eye in the same manner as if testing fluctuation in other parts of the body.

Importance of the digital method

- It is a rough estimation of IOP.
- It is useful if IOP is markedly elevated or markedly decreased but too slight elevations cannot be tested by this method.
- It needs experience.
- It is also a useful method for making a comparison between the patient's two eyes.

Method of recording

We use the following abbreviations:

- Tn (normal)
- If elevated: Write T+, T++, T+++
- If low: Write T-, T--, T---

Indentation (Schitoz) tonometer:

The depth of indentation of the cornea (anaesthetised with benoxinate topical anaesthetic drops) made by a weighted plunger is measured by a lever which travels over a scale. This scale is 2 cm (20 mm) divided into 20 grades.

The softer the eye, the deeper the plunger indents the cornea giving a higher reading on the scale. There are 4 different weights (5.5, 7.5, 10, 15

gms). The readings obtained on the scale are transformed into approximate value of IOP from a special chart.

The indentation method is not so accurate because it is affected by corneo-scleral rigidity which is subject to wide individual variations but it is useful for:

- Comparative measurement of the two eyes of the same patient.
- Successive measurements in the follow up of the same eye.

Applanation tonometers

Types

1- **Goldmann applanation tonometer**
Mounted on a slit lamp

2- **Hand applanation tonometer**
e.g. Perkins tonometer

Technique and idea of Goldmann applanation tonometer

The patient sits and fixes his head onto the slit lamp. The cornea is anaesthetized and one drop of fluorescein is applied into the conjunctival sac.

The tip of the prism of the applanation tonometer is gradually moved to touch the cornea by its flat circular plate (tip of the prism). 2 green half circles appear, we increase the amount of pressure applied by the tip of the prism till these 2 half circles just touch each other by their edges.

At this moment the amount of force applied by the prism is equal to the IOP. At this moment the tip of the prism causes flattening of an area of the cornea with 3.06 mm diameter.

The air puff non contact tonometers

- It is used for measuring the IOP in:
  a- Uncooperative patients not tolerating corneal touch.
  b- After intraocular surgery (for recently operated) to avoid corneal touch and risk of infection.
- We do not use topical anaesthetic because we do not touch the cornea.

Fig. 10-a: Schiotz tonometer.

Fig. 10-b: Using Schiotz tonometer.

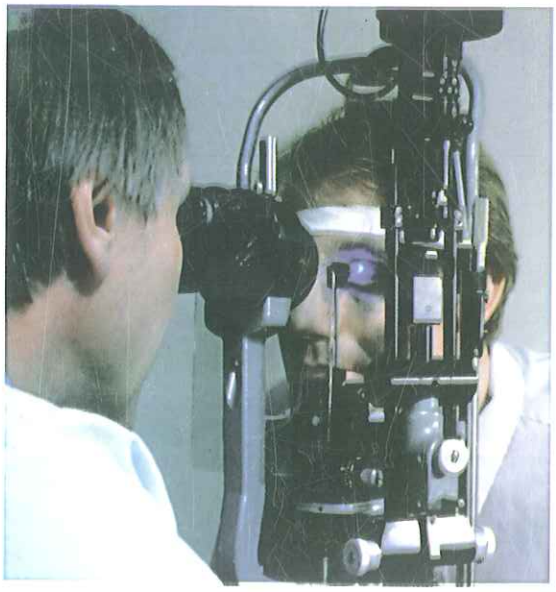


Fig. 10-c: Applanation tonometry.

Fig. 10-d: Examiner's view in Applanation tonometry.

EXAMINATION OF THE FIELD VISION

The field vision is that the portion of space in which objects are visible during the steady fixation of the gaze in one direction.

The normal visual field comprises a central area: the **central field** extending to 30° in every direction from the fixation point & a peripheral field the boundary of which is modified by the configuration of the orbital margin & nose and by the position of the eyeball in the orbit.

- Normal extent:
  - 60° nasally.
  - 60° upwards.
  - 70° downwards.
  - 90° or slightly more temporally.

- The extent of the normal visual field varies according to:
  - The **size** of the test object.
  - The **colour** of the test object.
  - The **intensity** of the illumination of the test object.
  - The **contrast** between the test object & its surroundings.
  - The **state** of adaptation of the eye.
  - The **cooperation** of the patient.

Perimetry is a highly subjective examination & is markedly variable with fatigue & reduced concentration.

A rough method but an easy one to assess the visual field is the confrontation method which is done if the level of VA is > 1/60:

The **surgeon** sits facing the patient at a distance of 2 ft. The patient covers his left eye with the palm of his hand. He is told to look straight into the surgeon's left eye. The surgeon closes his right eye. He then moves his hand in from the periphery towards the common line of vision of the patient's right & his own left eye, keeping his hand in the plane half-way between the patient & himself. Directly he sees it himself the patient ought to say that he also sees it. The movement of the hand is repeated in various parts of the field.

This method is extremely simple, rapidly applied & an excellent test. It will be seen that the surgeon compares the range of the patient's field by that of his own which may be considered normal. Moreover, he is continually watching the patient's eye, so that he can at once observe any deflection from the point of fixation.

- If the **VA is < 1/60**, an estimation of the peripheral field is done by **projection of light** from different directions & asking the patient to indicate, while keeping the straight ahead gaze, from where the light comes?

  This test is done in a dimly lit room with an intense light.

Accurate testing of field of vision is called perimetry:

- **The perimeter** consists essentially of a half sphere on which a spot of light can be moved, e.g. **Goldmann's perimeter** , or a rotatable arc, capable of being revolved round a pivot & along in a test object can be moved **(arc perimeter)**. The former is the more standardized. The chart, which had concentric circles marked upon it corresponding to degrees of the arc is under the surgeon's control at the back of the perimeter.These perimeters are manual ones.

- **Computerized perimeters** are more recent & more accurate than manual ones .

- For more accurate investigation of details of central field, **Campimetry** is employed to examine the central field. It consists of placing the patient 2 m from the centre of the large black screen 2 m in diameter **(tangent screen)**. He fixes a spot in the centre of the screen and small white targets in the form of discs, 1-5 mm in diameter, attached to long black rod are brought in from the periphery on a level with the screen.

Some points & definitions :

- **A scotoma** is an isolated area of diminished or lost retinal sensitivity within the field, surrounded by an area of normal vision.
- **The blind spot** is a physiological scotoma.It is an absolute negative

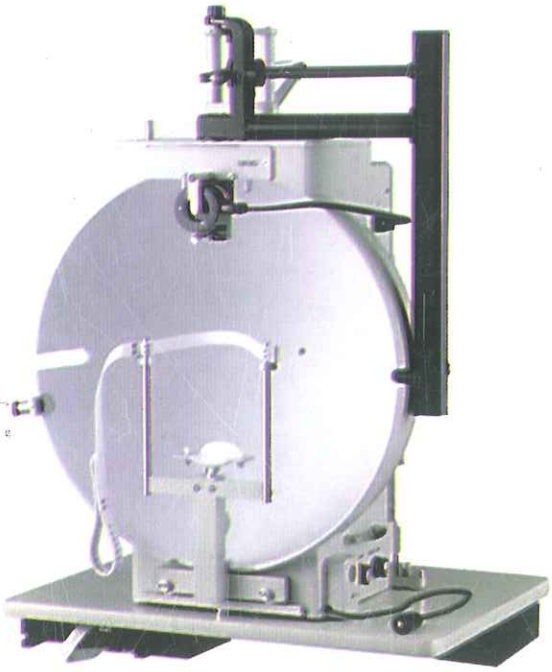


Fig. 11-a: Goldmann perimeter.

Fig. 11-b: Goldmann perimetry.

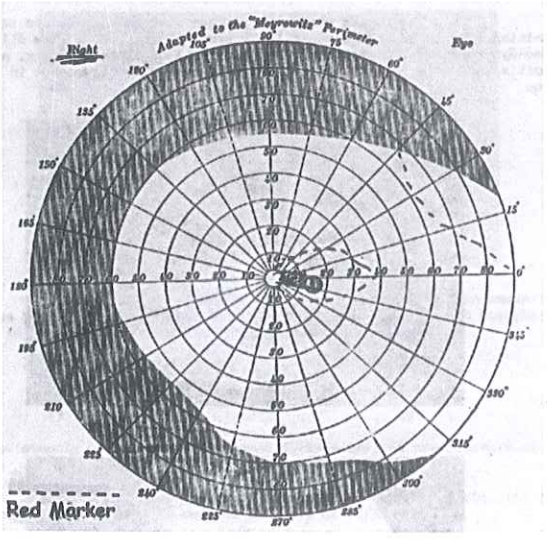


Fig. 11-c: Right eye field by Goldmann.

Fig. 11-d: Computerized perimeter.

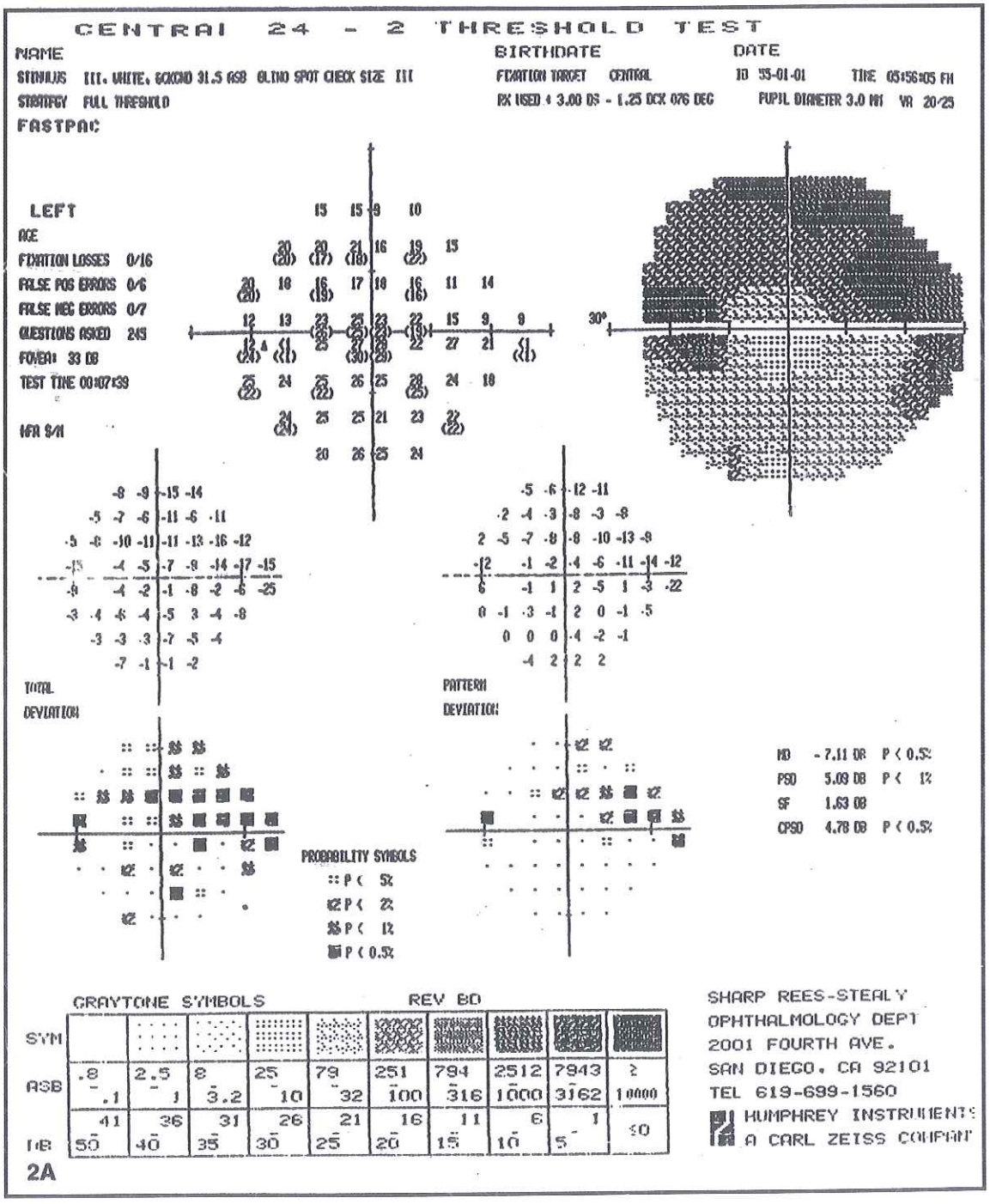


Fig. 11-e: Computerized perimeter print-out.

scotoma. It is always detected in the normal field of vision since it corresponds to the optic disc which is insensitive to light as it contains no photoreceptors.

- **Positive scotoma** is present when the patient sees in his field of vision dark patches against an otherwise plane white background. They are usually due to lesions lying anterior to the rods & cones but not involving the ganglion cells or their optic nerve fibres.
- **Negative scotoma** is an isolated defect which the patient is unaware of,but detected by perimetry.
- **Negative scotoma** may be either absolute or relative.
- The scotoma is **absolute**, when the perception of light is entirely lost over the defective area which, thus, doesn't vary in extent by changing the size or colour of the test object.
- In contrast, **a relative scotoma** is due to a diminished perception of light or to loss of perception of certain colours over the defective area and therefore its extent varies by changing the size or colour of the test object.
- **Concentric contraction** of the field: in this defect the whole field is equally diminished in size without being altered in shape.
- **Local contraction of the field:** This means that one part of the field involving the periphery is affected. If the defect is bounded roughly by 2 radii of the field, it is called a sector defect. If the radii are either vertical or horizontal, thus cutting off half the field, the defect is known as hemianopia. Again if the sector defect is bounded by vertical & horizontal radii quadrantanopia result.
- Hemianopia is called homonymous (right or left) when the corresponding half-fields of both eyes are involved & heteronymous (crossed) when both outer (bitemporal) or both inner (Binasal) half-fields are affected. When the homonymous defects are symmetrical in position and identical in all aspects they are called congruous, but if they are unequal in extent of intensity, they are called incongruous.

RED REFLEX

In ordinary circumstances the pupil looks black, and no reflex is obtained from the fundus. To visualize the red reflex the pupil should be fully dilated the patient is taken into a dark room and seated with the electric light above and behind the back of his head so that his face is to be in the darkness.

The observed sites in front of the patient at one metre distance. The observer reflects the light from a **plane mirror (with a hole)** into the patient's eye. The fundus appears orange red in colour, when the observer looks through the hole. The red colour of the fundus is due to the blood circulating in the choroid. **The red reflex can be also examined by using the direct ophthalmoscope.**

Varieties of red reflex

- **The red reflex** is absent in cases of dense vitreous hemorrhage, mature and hypermature cataract.
- **Grey reflex** in retinal detachment.
- **Yellow reflex in:**
  - Retinoblastoma.
  - Pus in the vitreous.
- **Opacities** on a red background in incomplete lens opacities such as nuclear, posterior subcapsular and immature cataract.

NORMAL FUNDUS

Ophthalmoscopically, it presents an orange-red surface upon which the optic disc, the retinal blood vessels and the macula can be distinguished.

- **The optic disc:** Represents the exit of the optic nerve, it is usually circular, light pink in colour and has well defined margin. The centre of the disc presents a small depression known as the physiological cup.
- **The central retinal artery & vein:** Appear along the medial side of optic cup soon divide into superior and inferior branch,both of which

further subdivide into nasal and temporal branches. The retinal arteries have smaller caliber, brighter and straighter course than the retinal veins. The retinal vessels exhibit silvery reflections.

- **The macula:** Is situated temporal to the optic disc. It appears as a small circular area of deeper red colour than the surrounding fundus.
- In the centre of the macula there is a foveal reflection due to reflection of light from foveal depression.
- The retina: Is transparent, the colour of the fundus is derived from the choroidal vessels.

Type of ophthalmoscopes

Direct ophthalmoscope shows an erect view of parts of the fundus. The view is not stereoscopic because the examiner sees with one eye only. Also, it does not show the parts of the retina anterior to the equator. It gives magnification 14 times.

Indirect ophthalmoscope gives inverted binocular stereoscopic view of the whole retina & fundus even parts anterior to the equator of the eye. More important for examining cases of retinal detachment. It gives less magnification (Three times).

Fundus can be examined using:

- The ophthalmoscopes.
- Fundus contact lens with the help of slit lamp.

So the slit lamp is used:

1. To examine the anterior segment (cornea, Ant. Chamber, iris, lens).
2. To do gonioscopy (using the goniolens).
3. To measure I.O.P (using goldmann applanation tonometers).
4. To examine the posterior segment; Retina & vitreous, using the three mirror fundus contact lens.

RETINOSCOPY

Retinoscopy is an objective method of determining the state of refraction by illuminating the eye with a plane mirror and observing the direction of movement of the red reflex.

Technique:

- The pupil is fully dilated.
- The patient is taken into a dark room with the electric light above and behind the back of his head.
- The observer sits in front of the patient at one metre distance.
- The patient is asked to look straight ahead at a point at the end of the room.
- The observer reflects the light from **a plane mirror with a central hole**, or he may use a **self-luminous retinoscope** into the patient's eye.
- The mirror is first moved around a vertical axis and then around a horizontal axis.
- If the movement of the red reflex shadow is in the same direction as the movement of the mirror, it signifies hypermetropia or emmetropia or myopia less than one dioptre.
- If the shadow moves in the opposite direction, it indicates myopia more than one idoptre.
- If the shadow does not move, it indicates (point of neutralization) myopia 1 dioptre.
- If the red reflex moves "with", the observer successivly puts "+" convex lenses in front of the patient's eye till the movement "with" stops. This is the (point of neutralization).
- On the other hand, if the reflex moves against the movement of the mirror, "-" concave lenses will be required and increased till the movement again ceases.
- The result obtained in the objective examination acts as the starting point for the subjective estimation of the refraction.

Fig. 12-a: Direct ophthalmoscope.

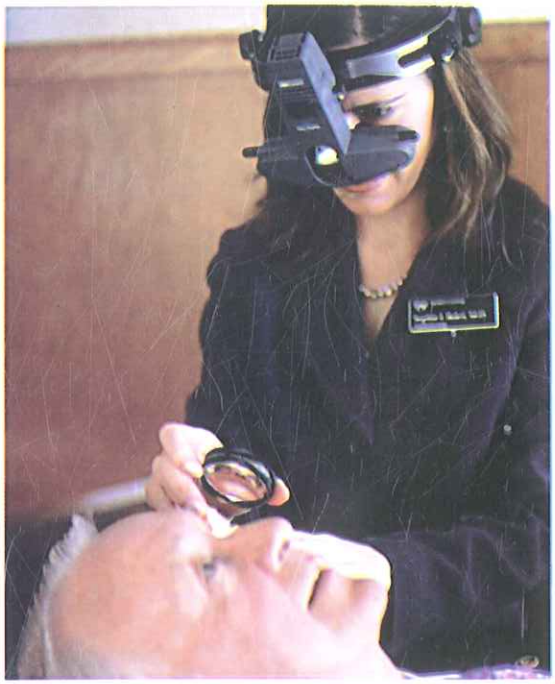


Fig. 12-b: Indirect ophthalmoscope.

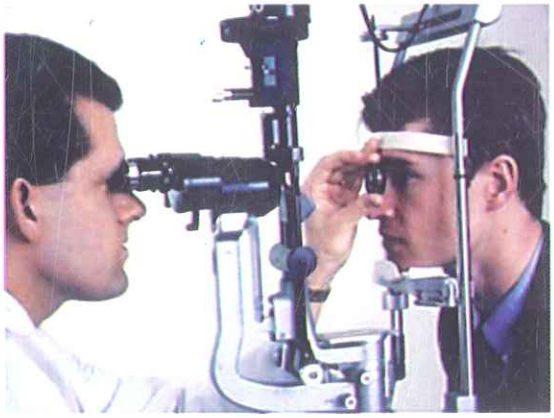


Fig. 12-c: Fundus exam. by slit lamp&fundus lens.

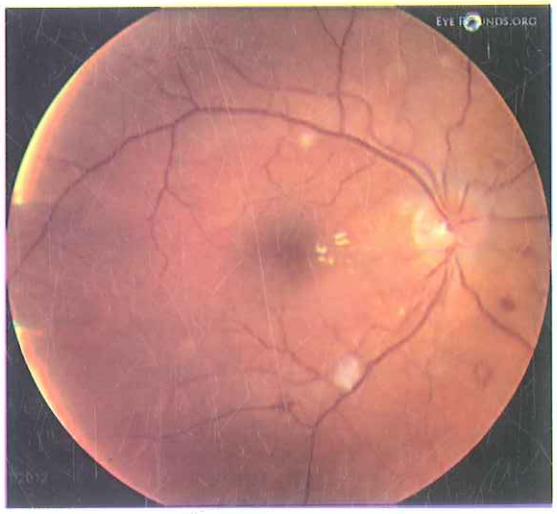


Fig. 12-d: Fundus showing hypertensive retinopathy.

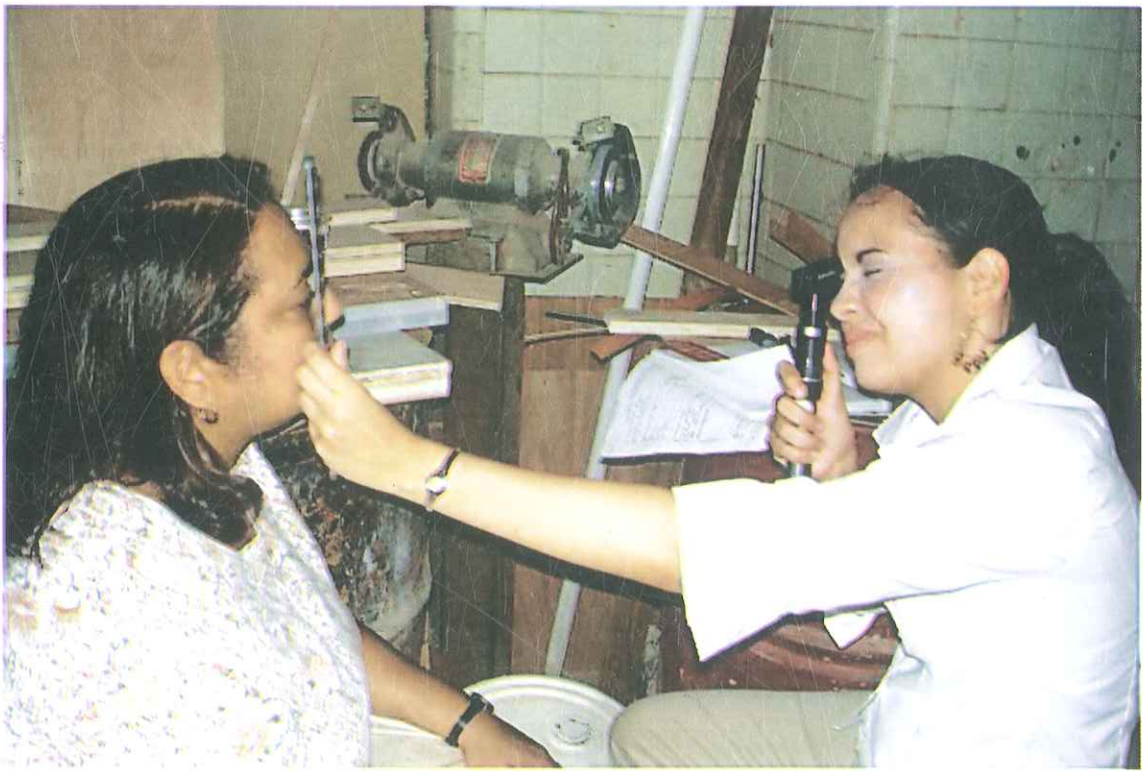


Fig. 13-a: Retinoscopy.

EXAMINATION OF THE ORBIT

The normal distance between apex of the cornea & the lateral orbital rim is usually < 20 mm (normal range 12-20 mm). It is best measured with **Hertel's exophthalmometer**.

Exophthalmos is present if the reading is > 20 mm in one eye, or a disparity of 3 mm or greater between both eyes even though both readings are within the normal range.

Pseudoproptosis

The first aim of the examination is to rule out pseudoproptosis, which may be due to enlargement of the ipsilateral eye from high axial myopia or buphthalmos, or may be caused by enophthalmos of the opposite eye. Other causes include asymmetry of orbital size & palpebral fissures (lid retraction, facial nerve palsy, ptosis).

Palpation of the orbit rim

This may reveal bony erosion or a mass (you should be familiar with normal antatomical landmarks).

1- The anterior lacrimal crest is easily palpable nasally as it blends with the inferior orbital margin.
2- The zygomatico-maxillary suture lies approximately in the middle of the infraobital margin. The infraorbital foramen is situated just inferiorly.
3- The lateral orbital tubercle, (to which the lateral canthal tendon is attached) can be palpated.
4- The frontozygomatic suture lies above the lateral orbital tubercle and is the most common site for a dermoid.
5- The supraorbital notch lies at the junction of the nasal & middle third of the superior orbital rim.
6- The trochlea may be palpated about 5 mm back from the orbital rim where the roof blends with the medial wall.

Orbital compression

This is performed by first pushing the normal & then the proptosed eye gently back into the orbit with the index of both hands. Increased resistance to retropulsion is suggestive of a tumor, but may also be present in thyroid ophthalmopathy.

Dynamic properties

Certain orbital lesions may rapidly change in size (capillary hemangiomas in infants, orbital varices in children & adults), pulsate (defects in the orbital roof or arteriovenous shunt), or be associated with a thrill and/or a bruit (carotid-cavernous fistulae).

In some cases, the proptosis can be precipitated by performing the Valsalva manoeuvre or by compressing the jugular vein (orbital varices), or the pulsation can be abolished by compressing the carotid artery (carotid-cavemous fistula).

Plain X-ray

Is indicated to diagnose orbital wall fractures and radio-opaque foreign bodies.

CT scan and MRI of the orbit: Refer to investigative ophthalmology.

Fig. 14-a: Thyroid ophthalmopathy.

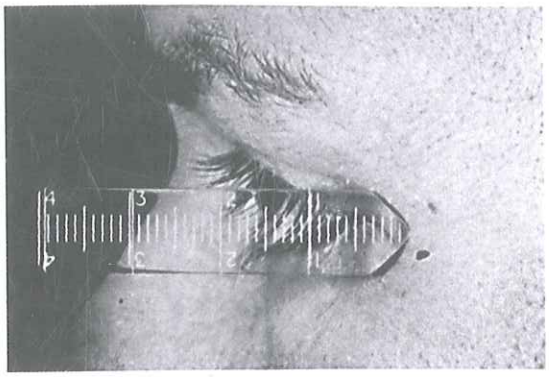


Fig. 14-b: Measuring proptosis by a ruler.

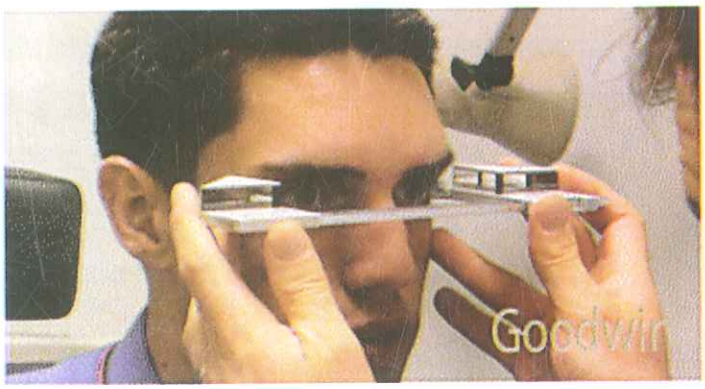


Fig. 14-c: Hertel's exophthalmometry.

INVESTIGATIVE OPHTHALMOLOGY

Here is a variety of different ophthalmic investigative techniques and their uses and indications

- **Colour vision testing:** (indicated inmacular disease,optic nerve disease).
  Technique: The most commonly used test is polychromatic **plates of Ishihara.**

- **Tonography (aqueous outflow studies):** this is indirect measurement of the rate of aqueous outflow form the anterior chamber. It is useful for actual diagnosis of chronic glaucoma when difficult. Tonography is based on change of IOP occurring while an electronic schiotz-type tonometer is applied to the eye for 4 continuous minutes.
  The graph continuously record the decrease in intra-ocular tension, and the difference between the first, and the last reading is correlated with this graph to determine facility of aqueous outflow.

- **Visual Field Testing:** To determine the outer limit of visual perception by the peripheral retina as well as the varying quality of vision within that area.

- This test is important for diagnosing, and localizing, and follow up of diseases in the visual pathway from the retina to the occipital cortex, and those of the brain.

- With one eye fixing on a given test object, the sensitivity of various areas of visual field of each eye separately may be tested with varying size,illumination and colour of test objects moved throughout that field.

- Coloured objects are less stimulus to the retina than white objects of similar size.

Techniques

Visual field is examined by:

1- **Amsler grid:** by this test it is possible to detect earliest macular changes (maculopathies), and their progression as well as to detect any scotomatous defects encroaching on the 10 central degrees of vision. It

is a chart of 10 cm lined square grids, 5 mm square and is held at 30 cm from the patient's eye, the patient stares at the center of the squares, one eye at a time.

2- **Confrontation:** This simple test provides a rough estimate of the patient's visual field by comparing it with the examiner's visual field (assuming that it is normal) to pick up gross alteration in field defect.

3- **Perimetry:** for accurate determination of the peripheral extent of the visual field, special equipment as a Goldmann perimenter or automated perimenter as octopus is needed. In addition to varying target size, most perimeters can vary target brightness as well.

The entrie 360 degrees of field must be mapped out.

Types of perimeters:

- **Goldmann perimetry** is kinetic testing, and involves moving a test object form non-seeing areas of vision. Size is graded form I to V. (0.25- 64mm), luminance is graded form 1e to 4e.
- **Automated perimeters** are static (non-moving) test targets flashed at different locations. Most provide normal values and compare the patient to normal in the print out of the result.

4- **Tangent screen:** visual field defects in the central field(central 30 degrees) may be picked up using this simple test of kinetic perimetry (moving form non-seeing areas of vision).

- The patient is seated 2 m form a 2 m^2 black screen with a direct line of fixation on the central object in the tangent screen. A3 to 50 mm white test object is brought in from the periphery to central fixation.

5-Colour fields with red and blue test objects are most useful in central 15 degrees of vision to detect toxic retinopathy.

OTHER TESTS WHEN NEEDED

- **Tear Quality Test:** which entails tests for the presence of mucus, protein and tear film stability.

a- A conjunctival biopsy, to ascertain the presence or absence of mucin-producting goblet cells which lower surface tension of tears Biopsy is taken form lower nasal conjunctiva (highest goblet cell population).

b- A qualitative mucous assay using periodic acid Schiff stain for its presence.

- **Trans-illumination:** intense light, placed on the sclera behind the ciliary body in successive quadrants will be transmitted inside the eye, where it produces a red reflex in the pupil. Intra-ocular masses as malignant melanoma will block light, preventing red reflex, but this is not the case in retinal detachment.

- **Exophthalmometry:** The exophthalmometry (Hertel) is used to determine the degree of anterior projection or prominence of the eye in cases of exophthalmos, the normal range of exophthalmometry is 12-20 mm Readings more than20 mm,or disparity of 3 mm or greater between the two eyes needs further investigation for the cause of exophthalmos.

- **Keratosocopy or placido-disc:** This simple test is useful in detecting corneal reflex regularity and irregular astigmatism as in early keratoconus. The examiner holds the keratoscope to his eye, and observes the illuminated cornea of the patient through the central aperture.

- **Keratometry:** This instrument is used to measure the corneal curvature of the central part of the cornea (1/3) in two perpendicular meridia to detect astigmatism and keratoconus.

- **Corneal topography:** is a sophisticated instrument to measure the diopteric power and curvature of all parts of the cornea for detection of any degree of astigmatism and keratoconic changes.

MORE ADVANCED AND HIGHLY SPECIALISED TECQNIQUES

A-Fluorescein angiography

This is a valuable tool in the diagnosis of a large number of retinal disorders that affect the retinal vessels, chorio-capillaries, Bruch's membrane and retinal pigment epithelium and iris lesions.

The fundus fluorescein angiography: May provide three kinds of information:

a- Anatomic details of the fundus.
b- Physiologic information about retinal circulation.
c- Documentation of the fundus pathology.

Technique

a- Through a dilated pupil, the fundus is photographed by a fundus camera equipped with exciter and barrier interference filters, which allow green light only from fluorescent dye passing through the vessels to be recorded on the film, outlining the vascular pattern and pathologic structures contained there in.
b- 5 ml of 10% fluoresecin sodium is injected in the antecubital vein. Photographs are taken after 5 seconds and then every second for 15 seconds more, and then after an hour or more for cases of retinal oedema or sensory pigment epithelial detachment. **Severe allergic reaction or anaphylaxis may occur in some cases.**

Stages of normal angiogram

a- Choroidal flush phase (choroidal circulation): earliest to appear.
b- Arterial phase (retinal arterioles).
c- Arterio-venous phase (retinal arterioles + capillaries, early venous: with laminar stainging of veins).
d- Venous phase (initial laminar flow along walls, then complete filling).
e- Recirculation phase.

Interpretation

a- Pseudofluorescence: reflected illumination of stained vitreous.
b- Autofluorescence: True fluorescent structure as drusen of optic nerve had.
c- A window defect: is a localized deficiency in retinal pigment epithelium through which chroidal fluorescence is seen.
d- Pooling is accumulation of dye in a tissue space.
e- Staining is an increased accumulation of dye within tissue.
f- Blocked fluorescence is interference with visualization of the normal underlying choroidal fluorescence, as presence of retinal haemorrhage.
g- A filling defect is an area of decreased fluorescence where circulation is occulded.

- **Fluorescein angiography of the iris:** is performed to document abnormal vascular patterns, tumours, ischaemia, and inflammations. Performed on fundus camera by adding plus lens to the optical system, pulling the camera further back and focusing on the iris. Photography is delayed a few seconds longer than retinal angiography.

A- Electro-retinography (ERG) (testing or recording the action potential of the retina)

This is an important instrument in the detection, and evaluation of hereditary and constitutional disorders of the retina as Leber's congenital amaurosis. The ERG may also be used to rule out the retina as the level of blindness in certain conditions such as cortical blindness, dyslexia, and hysteria.

The test is performed by placing an ocular fitted contact lens electrode so that readings of electrical response from various parts of the retina to external stimulation by light may made. **The A wave** is form photo receptors, and the **B-wave** form Muller cells. Ganglion cells do not contribute to the ERG.

B- Electro-Oculo-graphy (EOG)

Is an electrical recording based on the **resting potential of the eye.**

1- Use in retinal disease: in situations where ERG is not sufficiently sensitive to pick up macular degeneration, as in Best's disease.
2- Use in eye movement: By placing the skin electrodes around the eye and using cornea as the positive electrode with respect to the retina, eye movement may be recorded using bitemporal electrodes.

C- Ultra-sonography:

Diagnostic ultrasonography has made possible the detection of intra-ocular abnormalities not visualized clinically because of opacification of the cornea, anterior chamber, lens, vitreous. It may also help to study pathology of the orbit.

In consists of propagation of high frequency sound-waves (15-10 megahertz), with the differential reflection of these waves from ocular and orbital structure in the sound beam pathway, the reflected waves create echoes that are displayed on a screen as in sonar or radar system, producting a picture that is amenable to clinical interpretation.

1- Two forms of ultrasonic testing are commonly used:

I- A-mode is one dimensional time-amplitude representation of echoes received along the beam path. The distance between the spickes provides measurement of tissues as globe length, lens thichness (Biometry).

The height of the spikes recorded on the screen is indicative of thickness and strength of tissue sending back the echo.

II- B-mode; here the echoes produced are presented as dots instead of spikes, by use of scanning technique these dots may by integrated to produce an echo representation of two-dimensional section of the eye.

The location, size, and configuration of structures are rapidly apparent with this technique.

Simultaneous use of A-and B-modes produces the most successful result.

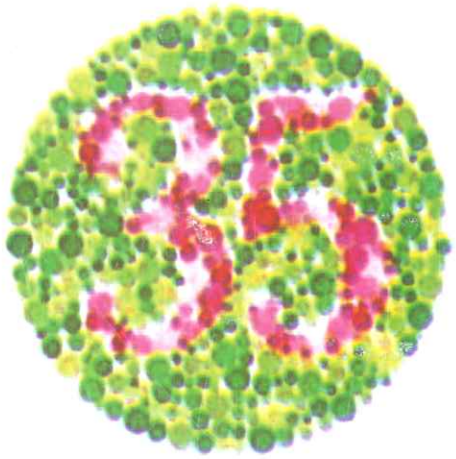


Fig. 15-a: Ishihara colour plate test.

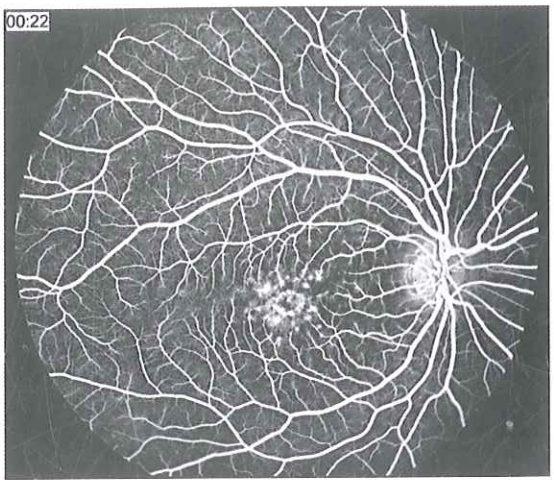


Fig. 15-b: Fundus fluorescein angiography.

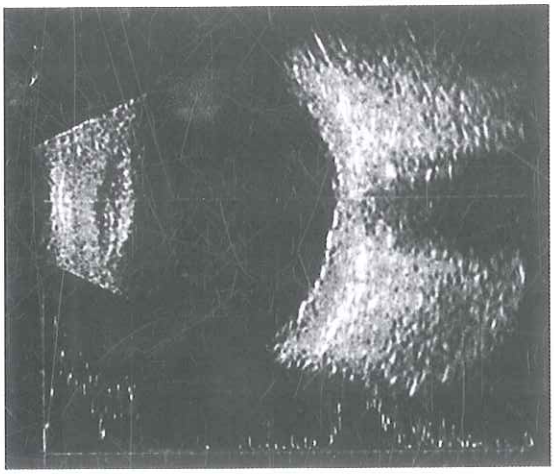


Fig. 15-c: Combined A&B scan ultrasonography.

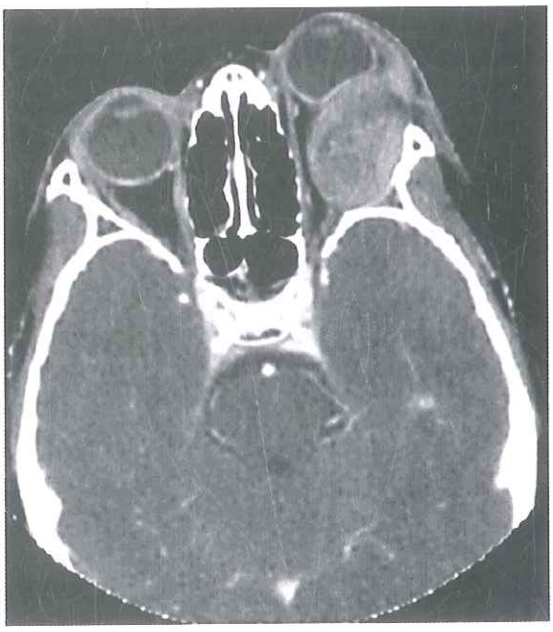


Fig. 15-d: CT scan of the orbit (proptosis).

2- **Technique:** Both types of ultrasound may be performed by either contact or immersion technique.

*a- **In contact method**,* a transducer probe like a pencil is held in direct contact with the eye or closed lid, using a topical anaesthetic with a viscous coupling agent. The major drawback of this method is obscuration of the first few millimeters of anterior segment and ciliary body.

*b- **Immersion technique:*** Here the eye is in direct contact with a water bath with the transducer tip held just beneath the water surface, but not against the eye. Anterior segment examination as well as examination of the deeper ocular and orbital structure is very successful under these conditions.

3- **Inerpretaion:** Ocular ultrasongraphy may be used to ascertain the size, shape and integrity of the globe.

*a- **Anterior segment examination:*** reveals out chamber depth and content, lens position and clarity and iris abnormalities.

*b- **Examination of the posterior segment:*** Vitreous haemorrhage, and membranes, retinal detachment, choroidal detachment and tumours all produce distinctive pictures that may differentiate one form the other.

*c- **Intra-ocular foreign bodies-detection and localization***, this is most accurately detected and located by a combination of A and B-scan ultrasound. Ultrasonography is useful for detection of non-radio opaque foreign bodies.

*d- **Orbital sonography*** for evaluation of soft tissue lesion causing proptosis. Fractures of orbital walls are not amenable to ultrasonic evaluation.

*e- **Biometry*** or measurements of axial length of the globe or depth of anterior chamber or lens thickness. This when coupled with keratometry reading is useful for determination of intraocular lens power.

RADIOLOGIC STUDIES OF THE EYE AND ORBIT

This is useful in evaluation of ocular trauma, foreign bodies and tumours.

1- **Routine X-ray:** is indicated to diagnose orbital wall fractures and radio-opaque foreign bodies.

2- **Computerized axial tomography (CT scan):**
   - The ability of C.T. scan to delineate tissues of varying density makes it an invaluable diagnostic tool. Routine CT scans are multiple axial and transverse "cuts", 1mm apart starting at the skull vertex and going to the skull base. Orbital, and extra-ocular examinatinons are enhanced by coronal, and sagittal sections.
   - Radio-opaque medium may be injected during the scan to demonstrate vascular abnormalities.
   - The CT scan is the study of choice in soft tissue injuries,intraocular foreign bodies and in cases of proptosis.

3- **Magnetic resonance imaging (MRI):** is being used in ophthalmology although very expensive, for the detailed imaging of global, orbital and neurophthalmic structures form the orbit through the brain. This technique is extremely safe as the patient is in a magnetic field and not exposed to ionizing radiation.

   MRI and/or CT are indicated in ocular trauma, tumours within opaque media where ultrasound is equivocal. Also for orbital lesions, and for detection of neuro-ophthalmic pathology. MRI is contraindicated if the foreign body is magnetic.

4- **Dacryo-cystography:** Refer to page 18.

ANTERIOR, CHAMBER ASPIRATION (PARACENTESIS)

- Diagnostic aspiration of aqueous form the anterior chamber is indicated for identification of intra-ocular microbes, inflammatory cells, and for determination of specific antibodies in the aqueous.

- 0.1-0.2ml of aqueous is aspirated by 30 – gauge disposable needle attached to a tuberculin syringe under topical anaesthesia.
- Diagnostic tests for aqueous include bacterial culture, parasitic or cytologic examination for malignancy. Also, Serologic examination of aqueous humour is of value if specific antibody is present in higher concentration than usual, indicating the presence of antigen in the eye as in toxoplasmosis.